REPORT RESUMES

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THE PLANNING OF EDUCATIONAL MEDIA FOR A NEW LEARNING CENTER.
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STEPHENS COLLEGE LEARNING CENTER WAS USED AS A MODEL FOR THE PLANNING OF LEARNING CENTERS UTILIZING THE MASS MEDIA AND NEW EDUCATIONAL TECHNOLOGY. IN THIS SAMPLE, THE PLANNING OF EDUCATIONAL MEDIA SYSTEMS FOR NEW FACILITIES WAS SEEN AS NECESSARILY AND APPROPRIATELY RELATED TO THE CHARACTERISTICS, PURPOSES, AND OBJECTIVES OF AN INSTITUTION. EDUCATIONAL MEDIA WERE REGARDED AND TREATED AS INTEGRAL PARTS OF ARCHITECTURAL AND EDUCATIONAL PLANNING. (LP)

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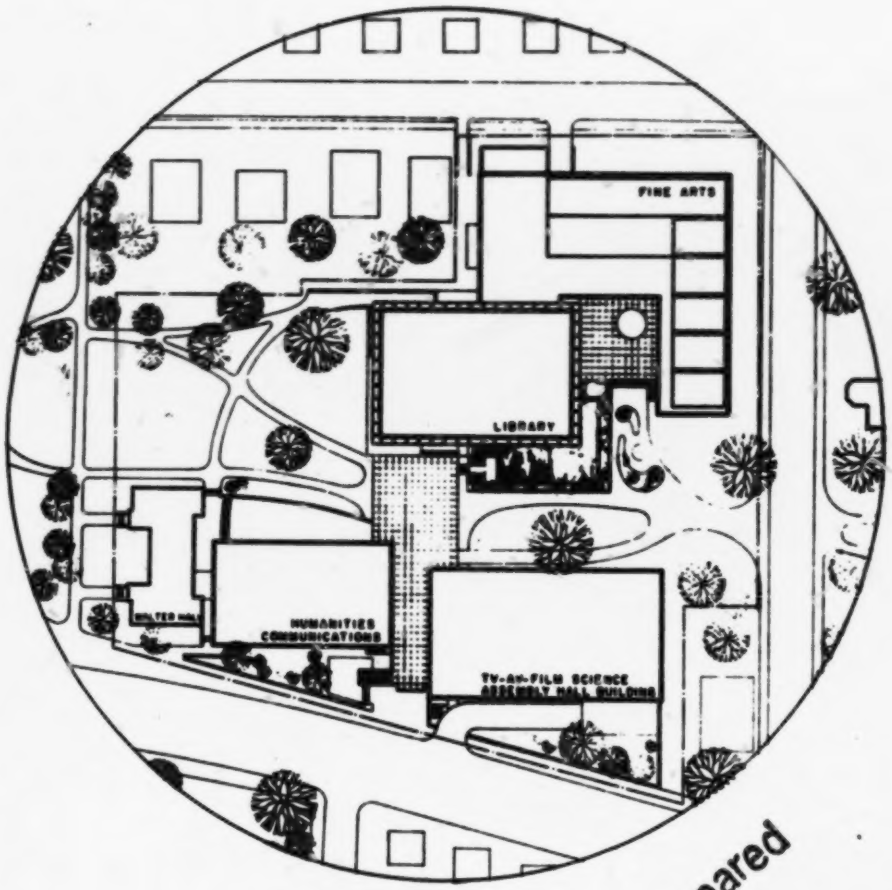
THE PLANNING OF EDUCATIONAL MEDIA
for a
NEW LEARNING CENTER
Stephens College, Columbia, Missouri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THE PLANNING OF EDUCATIONAL MEDIA
for a
NEW LEARNING CENTER

A Report by Stephens College, Columbia, Missouri

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Edited by

Ralph C. Leyden

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November 30, 1963

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PREFACE

This report, together with its appendices, constitutes that part of the contract between Stephens College and the United States Office of Education which specifies the preparation of "a manuscript which will describe plans, technical specifications, various alternatives, both those suitable for Stephens College and those suitable for other small colleges. the use for which the facilities were designed, and the goals sought."

The authors of the various parts of this report have sought to present the descriptions of planning, construction and projected use of the facilities of the Stephens College Learning Center in its new James Madison Wood Quadrangle as a case study applicable to other colleges and universities which are considering or planning similar instructional facilities designed to make maximum and integrated use of the whole range of the old and newer educational media. The authors have tried to keep in mind constantly the applicability to such institutions of the information presented. To help the reader understand the more specific, technological aspects of the report emanating from the study under the contract, this report includes a discussion of the College itself--its philosophy, curriculum, practices and climate for teaching and experimentation. It also includes a summary of the architectural planning which was executed and electronic and audiovisual aids included in the facilities.

Several individuals have contributed to this report. The material in Part I, Chapter 3 on educational objectives was submitted by the heads of the several departments represented and incorporates the contributions of many faculty members.

The whole of Part II, Chapters 5 through 12, is the work of J. W. Wentworth and L. V. Hollweck from Radio Corporation of America. They, with their colleagues, performed a theoretical and technological analysis of the Learning Center under a sub-contract with Stephens College. J. W. Wentworth also prepared the original non-proprietary technological specifications for the systems and equipment presented in Appendix A.

The concept and planning of the Learning Center presented in this report reflects the imaginative and dynamic leadership of Dr. Seymour A. Smith, President of Stephens College and of Dr. James G. Rice, Academic Vice President, and Mr. Gordon P. Freese, Administrative Vice President and the Stephens College Board of Curators. Recognition and appreciation are also due to the myriad of others--faculty, consultants, students and the many interested friends of the College in both industry and education who have contributed both directly and indirectly in the planning which constitutes the substance of this report.

This report is presented with the anticipation that it will be made readily available for wide distribution to colleges and universities which are planning to incorporate educational media facilities in new buildings, to architects and to industrial organizations interested in supplying education with needed systems and equipment for the extensive use of educational media which modern technology makes feasible and educational goals desirable.

Ralph C. Leyden

Neal Balanoff

November 30, 1963

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PART I

EDUCATIONAL OBJECTIVES AND THE LEARNING CENTER

Chapter 1

THE LEARNING CENTER PROJECT

One of the most important of the many upheavals that have taken place in education generally and in higher education particularly in recent years has been the tremendous increase in the use of educational media. The older and more familiar "visual aids" have increased in variety and application; education by closed circuit television has been introduced to many campuses and open circuit telecasts have been used for courses at all levels; programmed learning has been introduced into the curriculum to encourage independent study; many instructional materials have been transferred to film, video tape and slides with synchronized tape commentary. Such innovations have been both a result and a cause of intensive reexamination of the content of that which is taught and of the methodology by which it is taught.

Since Stephens College has long placed primary emphasis upon the importance of good teaching, it is understandable that it has involved itself with these newer developments designed to improve teaching and facilitate learning.

As the College began its planning for new educational facilities it soon became apparent that its plans for developing and incorporating integrated communication systems applicable to cross-media utilization for presenting the materials of teaching and learning represented a "first" in the design of educational facilities. The College was aware that outstanding examples of components of the potential integrated systems which it visualized might be found on various campuses throughout the country--for example, an excellent language laboratory in one place or a well designed assembly room in another institution or a synthesis of audio-visual and library services in still another. However, there was, as yet, no one place where all of these facilities were available and designed to be used in an integrated and mutually supportive manner.

As other educators learned of the planning for a new Learning Center which was going on at Stephens, their expressed interest suggested that the planning being done, particularly as it related to provisions for educational media, might have definite implications for other institutions. Among groups particularly interested were the Educational Facilities Laboratories and the Educational Media Branch of the United States Office of Education.

The Educational Facilities Laboratories supported the planning of the entire center by awarding the College grants totaling $77,500 to cover some of the costs of consultation, investigation and planning as these related particularly to the design and use of space and the inclusion of the newer media facilities.

The Educational Media Branch of the United States Office of Education expressed its interest by granting to Stephens College a contract for "The Planning Of Educational Media For A New Learning Center And The Preparation Of A Report Suitable For National Distribution". Both the College and the United States Office of Education recognized that this contract would enable the College to make a more thorough investigation and analysis of the technological and engineering aspects of the media systems planned and also provide guidelines and specifics to other institutions planning similar facilities.

J. W. Wentworth and L. V. Hollweck, of RCA Educational Advisory Services, who carried out this technological analysis under a sub-contract, give the following analysis of the status of the "audio-visual movement" and the place of the Stephens College Learning Center project.

"Despite the apparent growth of the 'audio-visual movement', the majority of educators agree that the potential benefits of technological aids to education are still largely undeveloped. While television and other technological aids are being used intensively in a few areas, there are relatively few colleges throughout the country where a truly optimum audio-visual program is in use. In most instances, instructional aids are used only sporadically, in makeshift environments, and as permissive appendages.

"Among the many and varied reasons usually cited for the relatively minor use of technological aids in American education are these:

1. The 'audio-visual movement' has historically grown up as a separate activity, divorced from curriculum planning. Many audio-visual coordinators or directors have tended to give disproportionate attention to clerical and custodial duties involving equipment, with little attention given to instructional materials and curriculum analysis.
2. There has been a general lack of faculty participation in the selection and use of available technological aids and materials.
3. Most institutions have failed to adopt a truly systematic approach to the use of audio-visual aids. One consequence of this failure is relatively great difficulty in obtaining materials when they are needed.

4. Neither buildings nor classrooms have been designed to employ technological aids to their full advantage.
5. The equipment available has serious design shortcomings, making it difficult to use in the educational environment.
6. Insufficient assistance has been given to teachers in the understanding and use of the newer media of instruction, especially in teacher training institutions.

"The Stephens College Learning Center project reported here is unusually significant in that it represents a major attempt to take corrective action with respect to virtually all of these problems simultaneously. Starting from a position of leadership in the application of traditional audio-visual concepts, Stephens College is now seeking to make optimum use of technological aids in a major complex of new buildings with a high degree of faculty involvement in the entire project. The experience acquired in this project, which will be freely shared with other colleges across the nation, should help to stimulate significant new developments both in technology and in educational practice."

It has been the purpose of all parts of the study reported here to subject the previous planning of the College to the objective scrutiny of experts familiar with the technology of educational media; to formulate basic principles governing the incorporation and use of communication systems and multi-media facilities; to formulate recommendations concerning design, equipment and utilization; and to report pertinent resulting decisions of the College regarding the educational media facilities of the Learning Center. It is also the purpose of this report to provide as much background as seems necessary for the reader to understand the systems and equipment planned for the Stephens College Learning Center which is located in its new James Madison Wood Quadrangle. It is hoped that these plans for educational media utilization in new instructional space and the resultant facilities will provide a model or prototype useful to other institutions planning similar facilities.

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Chapter 2

STEPHENS COLLEGE--AN EXPERIMENTING COLLEGE

To understand how and why Stephens--a college of 1800 students and a college for women--could and would undertake to plan and build such a pioneering educational facility as its "Learning Center", one must be somewhat familiar with the kind of college that Stephens is. Routine classifications do not readily describe it. Although it was one of the first colleges offering the Associate in Arts degree and participated actively in the junior college movement, it is more than a two-year college. Although it was a leader in the development of curricula for general education, its program emphasizes a wide range of liberal studies. Although it offers the degrees of Bachelor of Arts and Bachelor of Fine Arts, it does not consider itself a typical "four-year college".

Stephens is well described, although inadequately for some, as a college for women. Whatever undergraduate college level programs of education are pertinent to the needs of women are considered legitimate concerns of the College and subject to inclusion in the College's total program if the resources of the institution suggest the desirability and feasibility of such inclusion. It was with this point of view that the primary two-year program of the College was developed and continues to receive the major emphasis. It was also this point of view which led to the development of the Bachelor of Fine Arts programs in four fields of particular pertinence and importance to women--dance, music, fashion design and drama. It also guided the faculty thinking as it developed its newest program leading to a Bachelor of Arts degree for selected students, a program characterized by depth of study in a chosen area of concentration and by breadth of familiarity with the fundamental concepts and principles in the common disciplines. But, in addition, the Bachelor of Arts program for each student will be designed in terms of her particular aptitudes, competencies, academic interests and discernable life goals and expectancies rather than in terms of predesigned sequences of course experiences in the pattern of the traditional major and minors.

This same point of view--concern for the needs of women--justifies the current interest of the College in identifying the needs of women who are past the normal college age, but who desire more education either to enrich their own lives or to equip them to make new and useful contributions to their society. The College has pioneered in conducting pilot seminar study for such women and is continuing to study, through a faculty committee, apt and feasible means of satisfying the needs of this age group.

Contributing to two main streams in American education during the first half of the twentieth century--the general education movement and the development of junior colleges--the College was also known as an institution where effective methods of instruction were encouraged. It belongs both to the early group of experimental colleges and to today's group of "experimenting colleges".

It is evident that it is insufficient to describe Stephens by categorizing it in a simplified classification. It is perhaps best described as an undergraduate college for women, offering varied programs for varied needs leading to appropriate undergraduate degrees.

Under the leadership of James Madison Wood who served as President of Stephens College from 1912 to 1947 and that of W. W. Charters, Director of Research, the College sought to develop a program of education for women which committed the College: 1) to a program fostering the growth and development of each student in terms of her own interests and the needs of society; 2) to providing a basic general education; 3) to stressing the central importance of religion and 4) to fostering experimentation in teaching and program development.

Dr. Roy Ivan Johnson in his book Exploration in General Education states the early convictions of the faculty and their leaders at Stephens in this way:

> "They believed that the business of general education is to fit the student for a successful and satisfactory life, as an individual and as a member of society. This belief dictates that education accept as its primary objective the development of individual attitudes and abilities necessary to competent and complete living.... They believed that the criterion for planning and implementing all learning experience must be the needs of the student. They believed that the essential needs and interests of men and of women are different in important ways and that therefore education for women must differ substantially from the training of men. They believed that in any need-centered program each individual student is the only valid frame of reference; and they reasoned that in such a program ways must be found to individualize instruction in order to satisfy the varying needs of individuals."

These beliefs have remained as a permeating influence in the evolution of the Stephens pattern of education and have guided the innovations which placed Stephens among the "experimental" colleges and which justifies its being termed an "experimental college" today.

Stephens College offers three degrees: The Associate in Arts, the Bachelor of Arts and the

Bachelor of Fine Arts. The major emphasis of the College is on the program leading to the two-year, Associate in Arts degree. It is intended that this program will continue to be the primary concern of the College. The Bachelor of Fine Arts degree is given in four fields: dance, music, fashion design and drama. It is expected that the enrollment in this degree program and in the Bachelor of Arts degree program will continue to be limited to a select group of students for whom these programs have particular advantages in terms of their aptitudes, interests and goals.

To carry out its program of education the College offers courses specifically designed to contribute to the general education of the student through a wide range of liberal studies and specialized courses in certain pre-vocational and vocational areas, including those of the Bachelor of Fine Arts curricula. The student's Associate in Arts program is almost entirely elective, but each student plans her program in consultation with her faculty adviser who maintains a counseling relationship with her throughout her years at the College. The heart of the general education program is the set of basic courses. These consist of Communication (English 1-2), General Humanities, Contemporary Social Issues, The Contemporary American Woman, Basic Beliefs in Human Experience (Philosophy 1-2) and Fundamentals of Natural Science. With the help of her adviser, the student chooses from among these basic courses and adds to them other courses which will enable her to achieve some depth of understanding in her special interest, whether this be in the field of liberal studies or pre-professional training or, as is most usual, both.

In carrying out its concern for the individual growth and development of each student, the College gives more than usual attention to the out-of-class opportunities for learning. Each hall has its own resident counselor, trained in personnel work, who works directly with students in the group living aspects of their education. The activities of the residence halls are integrated under the Civic Association, the student government organization, which is given a grant of power by the President for carrying out the functions of self-government. The extra-class activities of students which are beyond those in the residence hall are also a concern and the College provides faculty sponsorship and guidance for them.

Under a Dean of Religion, the College carries out its commitment to the importance of religion by providing a varied program of religious experiences--vespers, Sunday morning services, evening prayer, hall meditation periods and special convocations with religious emphasis. In addition, a student organization conducts a program known as the Burrall Program which includes a wide variety of opportunities for students to engage in social service projects within the community and surrounding territory. The Burrall Program also includes student arranged seminars, conferences and other special events which enable students to probe deeply into their own personal beliefs and commitments.

In carrying out its commitment to a continuous program of educational experimentation and research, the College encourages the undertaking of special projects which have specific implications for teaching and learning and also programs of study in which faculty members have particular scholarly interests. Each summer the College awards grants in both of these activities. Frequently as many as one-third of the faculty will be engaged in summer study extending from a week or two to much of the summer. Some projects are conducted as workshops with several staff members participating; others constitute individual assignments, the results of which will be shared with colleagues. The individual awards given faculty often involve foreign travel, opportunity to study off-campus or to write. In these ways the College seeks to foster a climate conducive to development of constantly more effective and efficient teaching.

It is under this program of grants and subsidies for special study that the College has most recently encouraged the thorough exploration, experimentation and development of new materials and aids related to the newer educational media. For the past three years the faculty has been engaged in as many as twenty to twenty-five different projects each summer. These have included several involving the production of programs utilizing closed circuit television. Others involved the development of programmed units utilizing synchronized slides and tape-recorded commentary in science, art, English and general humanities. The College pioneered in 1958 by adapting interviews and lectures via amplified telephone to classroom instruction, and presently is coordinating a series of courses originating on its campus and relayed to a group of cooperating colleges via amplified telephone. One project extending over three years has completely reorganized beginning language instruction based on modern linguistic analysis and utilizing programmed manuals and synchronized pictorial material capable of being presented in either single frame, series of frames or in motion for supplementing the instruction in meaning being given. Still other projects have resulted in the development of course materials in humanities, social studies, English and other subjects for use in study carrels. equipped similarly to language laboratory booths where students may check out cartridge tapes and study them.

These and many other projects, including critical reexamination of the content and methodology of basic courses particularly and a study of the College scheduling procedures and policies have had much significance for the Learning Center.

They have provided ideas both for its more functional planning and for creative utilization of its resources.

The College has also had a long association with the broadcast media, from the introduction of radio on the campus to disseminate religious programs in the early 1920's to the development of closed-circuit television for instruction in the mid-1950's. Today radio, television and film facilities continue to serve two major campus functions: 1) as a production center and dissemination system, via a coaxial cable, for live, taped or filmed presentations serving the instructional ends of many departments, and 2) as a well-equipped laboratory for instruction in broadcast production and performance for students enrolled in courses offered by the Television, Radio and Film Department and the Theatre Arts Department. Recent purchase of the first educational model of the Ampex VR-1500 videotape recorder as part of the Learning Center facilities will enable a third function, recording of instructional presentations for repeat or delayed use.

The combining in 1957 under one head, Radio and Film Department with the Audio-Visual Services achieved more coordinated use of the interrelated facilities.

When the closed-circuit television system linking sixty classroom and dormitory spaces was installed on campus in 1955 to provide a televised course for the entire entering class, the Department assigned students to serve as production crews for all presentations. This provides students with a meaningful laboratory experience and reduces production costs to a reasonable figure. Instructors in the Television, Radio and Film Department also serve as producer-directors for the service programs. This combination of responsibilities enables the instructional staff to maintain a professional status while teaching.

With such a history and such a climate for experimentation Stephens College feels that it can and must continue to be among today's experimenting colleges if it is to meet its commitments to students. As such the College feels that it may be in a position to make some useful contribution to the ongoing development of higher education along with the many other institutions similarly concerned.

The President of Stephens College, Seymour A. Smith, expressed the need for the experimenting college and our own readiness to be one. His statement both reaffirms the historical educational stance of the College and projects its commitments into the future.

"Our hope, as I see it, lies in the possibility of the emergence of a great number of institutions, large and small, infected with the experimenting spirit. Actually, this is already coming about, for many of the larger institutions are being forced into experimenting with new patterns, new methods and new resources by virtue of the almost impossible situations they currently confront.... For the good of higher education, we need a host of institutions working on one or several of the more promising avenues for improving learning, trying new patterns, doing the necessary research, and sharing their experiences with others.

"I hope we can be one of the more significant of these experimenting colleges.... The Learning Center, if we capitalize upon its potential, gives us new opportunities to push out the frontiers on which we have been working. Our leadership is needed not just because society and higher education need such aid as in large or small degree we may give, but because our students deserve the fruits of the most effective programming we have the imagination and resources to devise.

"Our commitment to being that kind of experimenting college has in effect already been made. It is symbolized in the brick and mortar of the Learning Center; it is more fundamentally demonstrated in the projects into which faculty are pouring their life blood; but it is to be found most of all in the spirit of openness and dedication to improvement with which we approach our work.

"To be such a significant experimenting college calls for certain conditions.

1. The College must have a plan. It must carve out for itself what it proposes to do among all the possibilities open to it, thus providing the framework within which and on behalf of which it will expend its experimenting efforts. We have such a plan projecting over the next ten years which incorporates our continuing commitment to the education of women, a modest enlargement of our student body, extension of our program in offering work for the Bachelor of Arts degree while continuing a primary emphasis on our two-year program, exploitation of new resources for learning and new patterns of instruction and plans for meeting the financial needs in support of this program.

2. An experimenting college must have a climate which is conducive to experimentation. Such a climate has several parts.

   a. There must be freedom for members of the faculty to try new things. I think we have that.
   b. There must be not just freedom but College encouragement to undertake projects which break old molds. We have that.
   c. There must then be a readiness on the part of the College to effect such substantial change as may be demonstratively promising.

I think as a college we have shown this readiness.

3. An experimenting college, by implication a changing college, must provide channels for clear understanding and a reasonable order for consideration of changes which are in the making. Both call for a heightened sense of responsibility on the part of faculty and staff in exercising judgments on proposed changes. We have these requisites.

4. Most importantly an experimenting college needs a faculty competently imaginative and daring and willing to expend extraordinary effort. This I am confident we have.

"In the years immediately ahead there will be tremendous challenges put to us and opportunities to bring new glory to the institution and more meaningful experience to our students. In responding daringly we continue an important part of the heritage of American higher education and by keeping on the cutting edge we extend the particular tradition of Stephens College. In continuing as an experimenting college we can help reshape American higher education in the years ahead and, more importantly, serve better the students to whose growth we are committed."

It is hoped that the Learning Center in its plan and utilization will so reflect the College itself--its philosophy and practices, its commitment to teaching and learning and to improvement through experimentation--that it will be accepted by those who use it as a highly functional educational facility. If it does this successfully, it can be an asset and an example as the College continues to play a part with others in meeting the changing demands of the future.

Chapter 3

EDUCATIONAL OBJECTIVES AND THEIR IMPLICATIONS FOR EDUCATIONAL MEDIA FACILITIES

Any institution which is planning an expansion of its educational media facilities in either new or existing buildings would do well to reexamine its course objectives, the range of methods currently being used in achieving them, and to identify the educational media currently employed and those which faculty consider needed. Even in an institution such as Stephens, where audio-visual aids and a range of educational media have long been accepted by teachers as instructionally useful, it is beneficial to conduct such periodic reexamination. Going through the process of course analysis in terms of objectives and content, relating these to learning theory and methodology and appraising the instructional resources available, not only familiarizes new faculty with objectives and resources, but acquaints older faculty with new developments including technological resources. This timely reexamination of the courses in several departments at Stephens gave the faculty an enriched perspective on how their courses might be taught, given the increased facilities, particularly educational media, in the new Learning Center. The procedure followed proved helpful in supplying information for further detailed planning.

A brief resume of the process and a summary of the most pertinent parts of the analyses made might serve several different purposes. Those readers from industrial organizations concerned with supplying the educational market with educational media systems, materials, and equipment may find this summary helpful as an illustrative case--familiarizing them with what teachers in several fields do, use, and need in accomplishing educational objectives. Readers from educational institutions may be interested in the pattern used for promoting faculty involvement in expanded utilization of educational media and methodological variety. The review also provides the reader with a background for understanding the plans of the Learning Center itself, described in detail in the following chapter, since consistent effort was made to fit the facilities to the educational functions they were to serve.

Three stages of faculty involvement preceded the work of the technological consultants whose analysis and recommendations constitute a major section of this report. First, faculty of selected departments were asked to analyze their educational objectives and methodology. Second, a large number of faculty representative of these same departments were sent to a national DAVI (Department of Audio-Visual Instruction, National Education Association) conference to familiarize themselves with new developments in the technology and use of educational media. Third, the College arranged a three day campus conference on educational media for all interested faculty to confer individually and in departmental groups with consulting experts in educational media.

These consultants, with the analyses and conferences as a background were thus in a position to discuss quite realistically with the planners of the Learning Center the needs that the facilities should meet in terms of systems and equipment. Further, the analyses gave the technological consultants from the RCA Educational Services considerable detailed information about teaching on the campus, which was useful in relating theory, practice and recommendations realistically.

The departments which were asked to submit analyses of the courses in their departments used the following outline as their guide.

OUTLINE FOR IDENTIFICATION OF EDUCATIONAL FUNCTIONS TO BE SERVED BY THE LEARNING CENTER

Stephens College, Columbia, Missouri

Will you please submit an analysis of the chief course or courses in your department using the categories below. The purpose of the analysis is to help clarify the relationship of objectives, methodology and facilities, including technological aids used or needed, preparatory to further planning of facilities in the Learning Center.

I. Objectives stated as broad outcomes

II. Objectives stated in terms of content

III. Identification of the range of teaching methods used

IV. Identification of educational media employed and needed

V. Identification of conditions desirable for teaching

  A. Possible class sizes for different objectives, varying from seminar to large lecture
  B. Optimum room size for different purposes
  C. Equipment needed (permanently assigned and available on request)
  D. Preparation facilities needed
  E. Assistance needed or useful from professional, semi-professional, technical, or student personnel.

As mentioned, analyses were developed for several courses, but only those for the "basic" courses are included here since they are large enrollment courses and are perhaps most illustrative of educational goals that institutions might have in common. These include courses in the following fields: Humanities, English, Philosophy, Science and Social Science. Although the analyses for these chosen were executed in considerable detail, space permits only a brief description of the objectives, methods and educational media that have specific implications for the planning or equipping of the Learning Center. These descriptions are identified below by field and basic course offered.

HUMANITIES: General Humanities

I. Objectives stated as broad outcomes

The aims of this course are three-fold:

A. To increase the number of arts the student enjoys and understands (These include Architecture, Literature, Music, Painting, Sculpture and the combined arts.)
B. To develop the realization that there are certain basic principles common to all arts
C. To introduce the student to means of formulating judgments of what comprises a valid artistic expression so that she may continue to apply what she has learned. In carrying out its objectives the course focuses attention upon basic factors in the understanding and enjoyment of the arts.

II. Objectives stated in terms of content

The complexity of the course content and its heavy demands upon a wide range of audio-visual materials presented by various media is best grasped by noting the basic factors treated in the course, the questions pertinent to them and the materials used in achieving understanding. These are given below.

A. Subject - What is it about?
    1. This involves a discussion of sources of subject matter such as Greek and Norse mythology as well as the Bible.
    2. This question also leads to a discussion of painting which is non-objective and to a discussion of the arts which are imitative and those which are non-imitative.
    3. Also the degrees of realism, distortion, abstraction, and symbolism are studied at this point.

B. Function - What is it for?
    1. This involves a presentation of some examples of arts and crafts.
    2. Architecture is taught by some instructors at this period.
    3. Some instructors use this unit as an opportunity for the emphasis on relation of function to the cultural history of a period.

C. Medium - What is it made of?
    1. Methods of identifying wood-cuts, etchings, lithographs, water colors, oils, fresco, tempera, and gouache are taught along with optional laboratory experience in the use of such materials.
    2. The materials of sculpture are studied by some.
    3. The materials of language and especially translations are studied by others.
    4. The instruments of the symphony

orchestra and the timbre of voices make up a large part of this unit.

D. Element - What are its parts?
   1. In painting, the elements of line, shape, value, hue, intensity, texture, volume, and perspective are studied.
   2. In music, the elements of melody, rhythm, harmony, tempo, dynamics, and timbre are studied.
   3. In literature, the elements of tone, color, meter, rhythm, imagery, and figures of speech are studied.
   4. Some instructors teach this unit in connection with organization.

E. Organization - How are its parts put together?
   1. Most instructors begin this unit with the skeletal and organic organization of paintings in which repetition and variation, contrast and balance, centers of interest, etc., are perceptible.
   2. In vocal music, the forms of carols, chorales, motets, ballads, art songs, arias, madrigals, oratorios, cantatas, passions, masses, requiems, and operas are studied, and in instrumental music, the forms of sonatas, symphonies, fugues, theme and variations, rondos, suites, and dance forms are studied.
   3. Forms of literature are studied with special attention to the organization of a play and a novel as well as the most common forms of verse.

F. Style - How does the artist reveal personality?
   1. Distinctions between classicism and romaticism are made.
   2. More is done with the visual arts of architecture, sculpture and paint-

ing because of the frequency with which technical names of style are used.

3. The "isms" are usually approached historically in architecture or sculpture.
4. Students are then urged to identify style in the literature they have read for previous assignment and music they have heard in concerts and listening hours.
5. Some instructors try to relate the individual style of the artist with that of his period.
6. Some instructors teach a unit of this at the very beginning and return to it again at the end of the course as a device for review and study on a deeper level.

G. Judgment - How good is it?
   1. Comparison of great with not so great is emphasized.
   2. Sources of criticism are examined.
   3. Examples of art are studied in pairs.
   4. Students are urged to express their preferences.
   5. In summary, the student is again and again brought back to the need for taking time to answer all of the above questions on subject, function, medium, elements, organization, and style carefully before making solid judgments.

III. Identification of the range of teaching methods used

The range of methods used in the course encompasses an extremely wide variety. Initial tests identify both advanced students and those with little background for assignment to both special sessions and individual projects work. The lecture, written assignments, televised programs on common topics, films, special listening hours for music, reference assignments in the library using both books and paintings, both local and out-of-town field trips for studying architecture and other art forms, charts and special departmental exhibits, special performances of the orchestra, are some of the methods and techniques used to accomplish the objectives in the course. Considerable use is made of the cultural events which are available during the year. These include symphony concerts, operas and a continuous theatre, as well as art exhibits.

IV. Identification of educational media employed and needed

As might be expected, the course draws heavily on educational media facilities. A partial list includes audio tapes of music illustrating the humanities text for both class use and for special assignments in listening hours. These are also available for independent study in the library. Other tapes made locally contain recordings of campus concerts and recitals and the audio portion of special closed-circuit television programs previously produced by members of the staff. Some outstanding campus theater performances have been recorded and are used. Still other tapes present campus interviews with visiting celebrities in the arts. Instructional material has been recently developed to accompany visual slides for the study of basic principles of art.

A wide selection of audio recordings is used, commercial monophonic and stereophonic.

Some films have been made on campus by members of the teaching faculty and are used both in the classroom and over closed circuit television. Other films are purchased or rented. The department has employed closed circuit television but in several instances was handicapped through lack of color. Programmed material employing both slides and accompanying tape for class or individual learning have been developed and used. Both original works of art and copies are used as a teaching medium in the visual arts.

The needs in educational media include several which would require new developments in the field to adequately satisfy. Recorded comments to accompany art gallery exhibits should be easily and readily available to students and other visitors in each of the display spaces used. Better devices need to be developed either through technique or mechanical adaptation to enable the instructor to quickly find a desired section in a tape or disc recording. Easier conversion of taped material to records and vice versa and techniques for alternating recording and dubbing from tape and record need to be developed. There is a need for a small sound-proof recording room in which a faculty member can develop his own materials. For educational purposes slides and machines for projecting them need to be standardized and made more rugged to withstand the constant and demanding use in the classroom. Having already produced some very useful films on the campus, the staff recommends several other topics for filmed presentation.

V. Identification of conditions desirable for teaching

This staff asks for a variety of sizes of teaching space: classrooms seating thirty or more, auditoriums seating 150 and 1,000.

Satisfying the educational media needs of this department suggests that the classroom should be equipped permanently with several most commonly used devices and that there should be readily available on a portable basis other less frequently used equipment. It also suggests the need for an efficient system of cataloging and issuing of a multiplicity of materials.

ENGLISH: Communication

I. Objectives stated as broad outcomes

Communication, which is the basic course in the department and is the foundation upon which the other offerings in the department are based, assumes that the proper study of communication is the study of the functions of mind: inquiry, judgment and a represention of passion.

II. Objectives stated in terms of content

A. The process of inquiry involves the student in a study of informal logic and the principles of investigation. He is expected to demonstrate his ability in inquiry by preparing an investigative paper drawing his subject from any of the academic disciplines.

B. The process of judgment takes the student beyond the determination of what is and into a consideration of worth or value. He studies the techniques of persuasion as the means of organizing logical inquiry to substantiate careful judgment.

C. A study of the representation of passion through literary expression brings the student to a consideration of poetry, drama and fiction. In the communication course he studies literature as a means of communication: A use of language which allows a common, symbolic participation into the emotional life of other men.

III. Identification of the range of teaching methods used

Many methods of presenting the material of the course are employed. Briefly identified they may be listed as follows.

A. The lecture-discussion. This is the most common method of teaching in the department.
B. The formal lecture. There is a growing interest in the use of lecturing for presenting information to large groups of students. Lectures by specialists within the department are shared by the whole department.
C. The tutorial or conference session. This method has proved most effective when treating individual problems in composition, reading or speech.
D. The use of audio-visual devices. The department has used or is using the following equipment:
   1. Motion pictures
   2. Commercial television or kinescopes of television materials and closed-circuit television for selected lectures
   3. Tape recorders
   4. Playback equipment and records
   5. Opaque projectors
   6. Overhead projectors

    7. Reading accelerators
    8. Learning machines (for grammar and sentence structure)
    9. Tachistoscope
    10. Slide projectors

E. Self motivated learning. There has been only minimal attention to this as a method of teaching, but some instructors have used taped lectures, continuous showings of kinescopes, and programmed material on basic skills, as well as the traditional individual-study methods, in teaching Communication.

IV. Identification of educational media employed and needed

Educational media in addition to those mentioned in III above, that are needed or useful in the teaching of Communication include the following:

A. More adequate facilities for using commercial films most effectively are needed. Highly desirable is a 35 mm. motion picture projector. An extension of the film library to include ownership of often used, feature length films should be considered. This department would like to have a regular film series sponsored by the College and planned to supplement our course and other courses. The best foreign and domestic films should be a part of this series.

B. Television--closed circuit or commercial--cannot really save time and energy for use until equipment is available for taping presentations. The effectiveness of TV would also be enhanced if mobile equipment were available for releasing the medium from the confines of the studio.

C. The use of audio recording tape would be extended if the mechanics were simplified. If the rostrum or lectern in each classroom contained a switch which would allow a teacher to record his lecture if he desired, these might be made available for students reviewing the lecture or for other faculty who might find the material useful. The taping might be done in a central control booth.

D. Playbacks of high quality operated from a central control and wired into classrooms with easily operated directional signals would simplify the use of recorded poems, plays and music. Implicit in this suggestion is the use of an intercom system.

E. Related to (D) is the suggestion that a system be built into the classrooms which would permit two or three instructors to unite in an auditory way for a lecture originating in any one of the rooms. These spaces might also be used for listening exercises originating from the central control booth.

F. With its concern for spontaneity the department would like to have available mobile, inexpensive, quick, reproduction equipment. Student writing might then be distributed to members of the class for close analysis and be retained for study. The suggestion is made, too, that equipment be made available in the library for reproducing pages of books or magazines which are not a part of the circulating collection.

G. In lieu of equipment described in (F), or perhaps in addition to it, the department recommends an easily operated and adequately lighted projector which would allow projection without darkness.

H. The machines using programmed materials interest the department. In addition to sentence structure it might be useful in teaching organizational patterns, logic, elements of poetry, and other such materials. Perhaps the most interesting possibility is the use of the machines for testing.

I. A few members of the department would be interested in educational devices to aid in teaching the skills of observing. This might be a combination of learning machine and slide projector.

V. Identification of conditions desirable for teaching

Since the objectives in the Communication course involve faculty in lectures to as many as 1,000 students and conferences with as few as one, they would like room sizes to do the various tasks effectively: Rooms to hold 115 (if three sections are to meet jointly); 30 (for comfortably handling a single class); 15-18 (for seminar or special interest groups); 6-8 (for small discussion groups). In these rooms for smaller groups informality should key the decoration and furnishing: lounge furniture in one; round tables in another. These rooms should be reasonably sound proof.

In the classrooms, permanently installed, or easily installed, there should be adequate blackboard space (boards that slide up, using the usually unused space above); a screen or surface for projection from movie equipment or other types of projectors; bulletin board space; and a television receiver placed for good viewing from any point in the room. A sound hook-up for recorded material or for receiving from other classrooms should be built in. An adjustable lectern with a switch control panel would give the teacher control of the available facilities.

The staff for its own best functioning would like comfortable private office space with seating for from 3-6 guests. Adequate and available secretarial and clerical help is essential and there is some feeling that this assistance should be extended to any professional activity--research, creative projects, etc. This should be augmented by the duplicating services and such clerical help as may be necessary for relieving the staff member of routine work: recording, gathering statistics, etc. There is a strong feeling also that though library facilities will be centralized there should continue to be a close association with a designated departmental librarian. The library might also inaugurate services to faculty of "pick up and deliver" from the departmental offices.

PHILOSOPHY: Basic Beliefs in Human Experience

I. Objectives stated as broad outcomes

   A. To help the student become intensely aware of herself as a human being, her beliefs, her unclarified presuppositions, and her feelings and attitudes which cluster about such fundamental philosophic and religious roots
   B. To help the student become aware of the inescapable questions which all reflective persons must ask about the meaning of life
   C. To aid the student in the development of a "philosophic attitude" through the process of philosophizing
   D. To help the student move toward a satisfactory philosophy of life.

II. Objectives stated in terms of content

The content of the course is planned in such a way as to engage the student in philosophizing in each class session and to aid her in becoming acquainted with issues and alternative answers in Western philosophy. Through regularly assigned reading and through writing of essays and papers, the course seeks to aid the student in independent study, critical evaluation of ideas, and the setting forth of her own philosophy. For resources, the course not only draws from classical philosophy, Plato's _Dialogues_, for example, but also such writings as Camus' _The Fall_, Frankl's _The Search for Meaning_, Fromm's _The Forgotten Language_, Smith's _The Search for America_, or Koch's _Philosophy in a Time of Crisis_.

The content is divided into six major units as follows (three each semester).

A. Existing: Self and Society
B. Symbolizing: Myth and Logic
C. Believing: Faith and Religion
D. Creating: Aesthetics and Metaphysics (feeling and form)
E. Knowing: Epistemology (sense and nonsense)
F. Ethics and History (freedom and authority)

III. Identification of the range of teaching methods used

The primary method of teaching the course by all instructors is a lecture-discussion approach. Some faculty lecture one session each week while reserving two sessions for discussion. Others lecture only informally, spending most of the time in dialogue with students, aiding them in the clarification of thought, in criticizing partially formed ideas, and in understanding alternative ways of answering philosophical questions.

IV. Identification of educational media employed and needed

Many educational media are currently used. Others need to be developed. For example, the course regularly makes use of films such as "The Death of Socrates" and "Reinhold Niebuhr on Ethics." Tape recordings and records of dramatic productions and contrasting types of sacred music from jazz to Bach are used at appropriate times.

At least three additional media show promise for effectively reducing routine instruction and providing possibilities for individual student study.

A. Programmed learning in the elements of logic offers the opportunities for out of class study by each student. Such programmed material might be available on "learning machines" to be followed by examinations. Programmed learning might also be developed in the routine field of philosophical concepts, the history of ideas, and Biblical history, freeing the teacher and the class time for the process of philosophizing.
B. There is a growing body of literature available on tape of major philosophers speaking, or the reading of significant philosophical essays. Such verbal presentation appears to aid many students in supplementing their own reading and understanding. These materials might be collected and made

available on repeating tape cartridges at various listening places.

C. Further experimentation should be made using the amplified telephone for groups to discuss philosophical issues with major leaders in the field throughout the country.

V. Identification of conditions desirable for teaching

Teaching has taken place on a log, in mud huts, or in air-conditioned modern classrooms. Nevertheless, ideal conditions make learning both easier and more effective. In order to achieve best results in the course, "Basic Beliefs in Human Experience", certain environmental facilities are needed:

A. The most desirable classroom is an informal seminar type room, permitting students to face each other, having a table for writing, and suggesting personal involvement rather than simple digestion of information. The ideal student size for regular class session is twenty to twenty-five.

B. For occasional lecture sessions, films, or listening, a room seating one hundred students is necessary. Such a room should be soundproof from the outside to eliminate disturbance and from the inside to avoid disturbing other classes.

C. One lecture room, seating three or four hundred is needed for occasional lectures to many sections of the course.

D. Each classroom should be equipped, or have already available, a high quality tape recorder and record player, plus equipment for film strips and movie showing. In addition to the environmental facilities, special provision for the optimum use of instructors' time should not be overlooked. This includes facilities for large group sessions and small seminars. Programmed learning and audio or video-tape should free the faculty from routine but important lecturing to many groups. Faculty time should also be given for individual conferences in giving guidance for independent student study.

SCIENCE: Foundations of Natural Science

I. Objectives stated as broad outcomes

The course in Foundations of Natural Science has two major objectives, both of which are based on the premise that it is essential that every college graduate have some understanding of science.

The first objective is to give a student some insights into the scientific process. This is in contrast to a student's becoming familiar with only the scientific product. In the former, the student is brought face to face with the heart of scientific activity by dealing with such problems as the following: the nature of evidence, how to collect data, how to handle data, how to interpret data, cause and effect relationships, inductive and deductive thinking, the structure of conceptual schemes, the nature of hypotheses, the nature of laws.

In the second objective, the epistemological structure of science as indicated above is meshed with the presentation of the "most" significant concepts in the sciences. The course is developed in a "logical" structure starting with the nature of matter and energy which becomes the necessary foundation upon which to build an understanding of cellular dynamics, cellular, organismic and species continuity, and biotic and environmental interrelationships. The attempt is made to present in depth a few key concepts in science that have made intellectual history or that hold the key for future history rather than surveying the whole of scientific thought. The attempt is also made to reveal the technological fruits of science as essential features of the deductive structure of science rather than as important details in and of themselves.

This course is designed to serve as a first and perhaps last course in science for a large population of college students. It must thus be included in the general education category. In addition, it provides a very solid and substantial base upon which a science major through understanding the structure and logic of the sciences can build his or her knowledge of science within the specialized fields of science. Thus, this course in fundamentals deals both with the process and the product.

Inasmuch as science is essentially an interplay of ideas and data, laboratory work allows the student to gather first-hand experiences in the attack on problems, and the management of physical apparatus, both simple and complex, in the emancipation of data.

II. Objectives stated in terms of content

Specific major concepts are presented in "logical" order so that the student can draw upon these concepts or principles in a host of theoretical and practical applications.

In the first semester, the student is introduced to atomic structure where the more basic particles of matter are brought together in organized units. The energies of nuclear structure and electron cloud structure are developed. Matter is then organized within the framework of the periodic table. The kinetic theory is then explored in some depth to get at some notion of the energy of motion, both in terms of molecules (heat) and in terms of kinetics of larger bodies of matter.

Toward the end of the first semester, the more complex organizations of matter are introduced. The origin and structure of organic molecules and problems of energy in organic forms are studied.

In the second semester, matter and energy are placed in the organic framework. The course starts with cellular structure and cellular dynamics which involves the energy processes of photosynthesis and cellular respiration. The story of the synthesis of organic molecules from assimilated simpler molecules is told. This is developed into a portrait of the organism as a highly organized reproducing whole. The organizing factor and reproducing factor lead to treatment of the multiplicity of cells and organisms.

The organic continuity of hereditary information is treated, and students become familiar with the concepts and problems in genetics. This is followed by the subject of species change and discontinuity-evolution. The semester ends with a broad view of the interplay of specialized organisms and populations in the biosphere. These concepts and models provide the basis for description, explanation and prediction.

Specific objectives in the laboratory consist of learning how to make maximum use of observational powers in conjunction with an organized mental and physical attack on a problem. The student indulges in a variety of laboratory experiences which are supposed to reveal the limitations of science, the confusion and clarification of cause and effect relationships, the necessity of an organized experimental design, problem development, the role of hypothesis, the role of theory, classification of data, etc.

III. Identification of the range of teaching methods used

A course of the type described above, of necessity, entails a variety of teaching methods. An analysis of the course structure indicates that certain blocks of information are necessary to progress with systematic analysis and synthesis. The most efficient ways of dispensing this information are via textbooks, reference reading and lectures. A more compact method than the usual textbook reading is the programmed text. Experimentation with this technique in a programmed unit in genetics developed at Michigan State University is now in progress. There are also plans for tape activited slide projection which can be used individually for sheer dispensation of information to students.

As an adjunct to the lecture, we shall use micro-lab demonstration projection, TV-microscopic projection and the usual filmstrips and movies.

In the laboratory, maximum effort will be expended in the direction of investigative type laboratories rather than in the illustrative type laboratories. The former is dynamic, the latter is static. Investigative laboratories, in the words of Bentley Glass of Johns Hopkins, provides an opportunity for "active participation of the learner in some real scientific invesitgation, and in some depth."[1] "The Investigatory Laboratory Exercise allows a student to engage in many of the aspects of the scientific process. Thus, he may expect to experience the frustrations of delays and failures, as well as the stimulus of creative work and the exhilaration of discovery."[2] Thus instead of learning about a Daphnia heart in terms of structure, one might learn about controlled vs. uncontrolled experiments by setting up an experiment testing the effect of drugs on the Daphnia heart. This is quite a different lab exercise with quite a different objective. Such laboratory experiences are not only needed but are presently being utilized at a greater frequence in this course.

In addition, field trips are a valuable adjunct to the other methods of instruction. Student projects in a limited way with carefully selected students prove useful in getting at some of the independent experiences necessary in a real understanding of science. Seminars for particular groups of students are being carried out. Also a visiting lecturer program brings prominent scientists directly to the students in an exchange of ideas of the more formative type.

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1. Biological Science Curriculum Study Laboratory Volumes, 1961, page x.
2. Alfred Novak and Norman Abraham, The Science Teacher, Vol. 29, March 1962, page 15.

IV. Identification of educational media employed and needed

A. Textbook
B. Programmed units
C. TV-macro and micro projection
D. Tape-slide units of instruction
E. Films
F. Film strips
G. Slides (2 x 2 Kodachrome)
H. Demonstration
I. Overhead projection
J. "Projecto-lab"
K. Microscope-slide instruction (including mike-slide library)

V. Identification of conditions desirable for teaching

The science faculty request rooms to accommodate individuals working on projects and programmed units, laboratory groups of 15-20, seminars and discussion for 20-25, lectures for 100-200. They also request microscopes, microscope lamps, binocular scopes, skeletons, charts, electric centrifuge, pH meters, large freezer-refrigerator, utility carts, slide files, tape-activated projection system, and microscope camera attachment. In addition, adequate preparation and project space with necessary equipment are requested.

SOCIAL SCIENCE: Contemporary Social Issues (The Organization of American Democratic Life)

I. Objectives stated as broad outcomes

This course presents a broad view of our American democratic society--its problems, ills, and, especially, its strength and capacity for change and development. It has three basic objectives

- A. To introduce the student to the basic contemporary social issues which every American must face
- B. To teach the individual how to study controversial social questions calmly and intelligently with an emphasis upon rational analysis rather than upon emotion and prejudice
- C. To develop in the individual such a profound interest in the solution of these issues that he will always take an active--and hopefully intelligent--part in civic life

II. Objectives stated in terms of content

The basic orientation of the course is a problem approach, and virtually all of the material is structured into a few major problems or issues. These problems are examined from multiple points of view, from the abstract, theoretical and the practical. To increase student motivation each unit is organized into a series of dilemmas or open-minded questions which compel the student to discuss and to think about the issues. Presently the eight units of the course include the following topics:

- A. The Nature of Social Change
- B. Democracy and the "Isms"
- C. The Politics of American Democracy
- D. Personal and Social Disorganization
- E. Race and Cultural Minorities
- F. The American Economic System
- G. American Foreign Policy
- H. Living in the Mass Society

In order to give the students sufficient background for choice making, reading lists are provided which point up both sides of the issue. Students are required to read such books as _Top of the World_ by Hans Reusch, _The Basic Principles of Democracy_ by John A. Decker, _Today's Isms_ by William Ebenstein, _Democracy in America_ by Alexis de Tocqueville, _Guide to American Government_ by James A. Burkhart, _The Making of the President_ by Theodore H. White, _The Shook-up Generation_ by Harrison Salisbury, _Race and Nationality in American Life_ by Oscar Handlin, _The Making of an Economic Society_ by Robert Heilbroner, _The Future as History_ by Robert Heilbroner, _Goals for Americans_, Report of a Special Presidential Commission.

III. Identification of the range of teaching methods used

While both lectures and discussions are used extensively, several other methods are also employed to promote genuine student involvement with real social issues. Some of these are listed below.

A. Tape recording. By going out in groups of two or three and tape recording interviews with local people who are immediately involved in a specific problem, the housing director, for example, students are helped to see and understand problems as they exist and to observe the variety of approaches to their solution. These tapes are then used by the whole class in their discussions.

B. Amplified telephone interviews. The range of possibilities and the excitement of this technique is almost beyond description. Since 1958 classes have interviewed many of our leading national political and educational figures, getting involved in a way that would be hard to duplicate. When an interview with a certain person is announced, e.g. Presidential Press Secretary Pierre Salinger, the students spontaneously seek out information on the man and begin to formulate questions to put to him during the interview. Through a series of such experiences they are able to comprehend much more adequately the nature, urgency, and significance of governmental, social and economic problems.

C. Classic Film Project. In the Contemporart Social Issues course, ten units are covered, including matters such as race relations, economic problems, marriage and family problems, crime and delinquency. For each unit, the department arranges a free showing of a film classic which has its plot centered on that particular problem. For example, On the Waterfront has been shown during the unit on labor relations; The Last Hurrah during the political unit.

D. In-class films. The department also uses a series of films and film clips in the individual classrooms to depict more clearly certain problems and situations under discussion.

E. Out-of-town trips. Contemporary Social Issues classes make trips to institutions related to our social problems and how we meet them as for example, the Algoa Intermediate Boys Reformatory, the State Capitol Building, and the Fulton Hospital for Mental Patients. Classes have visited the Truman Library where students were able to interview President Truman, putting questions to him on a whole range of subjects. At an auto plant, they had an interview with management, with most of the questions centering on labor-management relations.

F. Community class trips. For example, individual classes take a one-hour field trip into the various local housing areas with the individual instructor accompanying his section and providing a running commentary on what they are seeing as they drive through the town.

G. Lecture series. Four outstanding speakers each year appear on a Foreign Relations Lecture series which has included many truly outstanding people, for example, Adlai Stevenson, James Reston, William Shirer, Barbara Ward, Eleanor Roosevelt, Madame Pandit. Students are prepared through discussions, readings and special talks. The day of the talk students may attend a question and answer period between the lecturer and the students where off-the-record comments are frequent.

H. Spring Government trip to Washington, D.C. and New York City. During this sponsored trip most of the time is taken up with interviewing the people who actually run the government. Before departure for the trip, the girls are briefed on the people they are going to interview and are encouraged to read on the different areas of government involved. For example, recently the group interviewed Supreme Court Justice Tom C. Clark, the Vice President's Chief Assistant, a State Department representative on world trade, and a Peace Corps representative, in addition to meeting the congressmen and senators from the home states of the girls going on the trip.

I. Extra Class groups. These include a Foreign Relations Club which meets twice every month with programs arranged using well known people speaking on international problems; Young Republicans and Young Democrats clubs; Challenge--an exciting group of the better students in the department who are eager to learn more on the specific subjects studied in the classes. A recent group was most interested in Conservatism vs. Liberalism. With a background from special readings, meetings were held and the topic discussed quite thoroughly. This study culminated in an interview over the amplified telephone with Senator Eugene McCarthy of Minnesota, in which students put certain questions to him about his liberal position.

IV. Identification of educational media employed and needed

A. More effective use needs to be made of television. More and more the major networks are producing programs that could be very beneficial in the classroom, but sometimes it is impossible to have the students watch them because of the evening hours when the programs are put on. Could it be possible to obtain films of these programs so that they could be shown later?

B. Better use of the tape recorder. The department has already accumulated a great number of tapes. These tapes need to be edited and catalogued for more effective use in subsequent classes. Planning needs to include selection of resource people who can be interviewed to improve the materials for various course units of work.

C. Films. Careful check needs to be taken of what films are available and which are most suitable and good for our purposes. The same thing can be said about film strips.

D. More planning should be done in regard to resource people. Who to bring in? And when? How to get the full use of them when they are on campus.

V. Identification of conditions desirable for teaching

   A. It is the consensus of the department that there should be great flexibility in class size. Faculty would like to have groups from 6 to 10 in seminar conditions, and, at the same time, to have all enrolled students under one or more instructors meet in an auditorium classroom. Other occasions require more individual or tutorial attention for the student.
   B. Optimum room size should vary from a small classroom with round table for 10 to 15 students to a small auditorium for 300 students.
   C. Equipment needed. Standard audio-visual instruments, e.g. projectors, slide projectors, tape recorders should be available for a cluster of classrooms.

The preceding pages have contained analyses of the objectives, content, methodology and employment of educational media in Humanities, English, Philosophy, Science and Social Science. Certain conclusions seem to follow from these analyses.

Each of these factors in the teaching-learning process should be considered in terms of its relatedness to the other factors rather than as a separate entity if the facilities provided and the process itself are to be improved. Too frequently the planning and provision for the last factor, educational media, have been divorced from the others.

Although there is already much utilization of educational media in the teaching in a wide variety of fields, there are also many more applications and developments possible and needed as seen by the teachers themselves.

Space and facilities need to be designed to maximize the efficacy of the teaching-learning process and to meet the needs visualized by teachers in higher education.

Attention should be given to all of these considerations in the planning and equipping of new facilities for higher education.

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Chapter 4

THE LEARNING CENTER--ITS CONCEPTS, PLANS AND FUNCTIONS

The concepts inherent in the planning for the Stephens College Learning Center grew out of the College's need for more adequate instructional space, out of a developing curriculum, out of changing patterns of education at the College, and out of the challenges to education that the whole nation has faced. They have grown out of self-questioning as to how this College as well as others can educate better and thus meet better these challenges to higher education.

This questioning culminated for Stephens in a conference held on its campus in February of 1959 called "New Frontiers in Learning." Subsidized by the Educational Facilities Laboratories, it was one of the first of such conferences on facilities for higher education supported by that Foundation. Twenty of the thirty-two people participating in it came from off-campus. The list of participants included a wide variety of interested persons, leaders in their fields, from education to manufacturing to publication. Each of them was concerned about the future of higher education--how it was to meet the challenges before it and what form new facilities should take to be of greatest use.

Starting from the common concern of the participants, that of providing highly adaptable space which would allow use of a variety of new methods and techniques and which would accommodate a constantly changing curriculum, the conference centered its discussion around two main questions: How do people learn? What kind of facilities are now making the greatest contributions to that learning and how will the needs of the future best be met? Stemming from the discussion of these questions, several themes ran throughout the conference. These and their implications, discussed in the official report[1], indicate persistent concerns. They are briefly summarized here because they relate closely to the subsequent planning of the Learning Center.

First, although technology has provided many new developments, such as television, video-tape, tape recorders, test scoring devices and data processing there has been relatively little adaptation of them to instruction in higher education. Second, adaptation of these devices requires the development of adequate theory and its testing through experimentation and a resulting reconsideration of the teacher's role. Third, students should be given greater responsibility for their own education and the new devices and methodology should help them achieve it. Fourth, the great expense of using some of the newer educational media and electronic devices can be justified only as larger enrollments within a college or a combination of colleges justify the expense. Fifth, a college must thoroughly understand itself and its educational objectives if it is to get useful assistance from technological experts in planning facilities which are functional for that institution. Sixth, a sharp distinction must always be maintained between the devices of instruction used and the content of the learning itself which is communicated through the devices. Seventh, since the relationships between space and function are variable, the best guarantee of future usefulness of space is to plan for as great flexibility as possible. Eighth,

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1. Mayhew, Lewis B., New Frontiers in Learning, Stephens College, 1959, pages 32-36.

to keep education humanized there must be maintained a tension between the reality principle, evidenced in the immediate application of learning, and the aesthetic or non-utilitarian principle. Learning should have room for both aesthetic satisfaction and individual experimentation. Last, education as a modifier of human behavior, even with the new approaches and aids visualized for the future, will undoubtedly remain a long and laborious process.

The intensive discussion of these themes resulted in certain implications which were subsequently useful as guidelines. The first implication, that buildings should evolve out of the purposes and character of an institution, necessitates a thorough analysis of the functions that a building must serve. The second, that only the most flexible buildings are apt to serve the rapidly changing process of education and make possible the application of technological advances, requires the most creative planning possible by both institutions and architects. The minimum design, for instance, for such potentialities should include networks of conduit capable of receiving necessary cables for electronic equipment--television, radio, learning laboratories, remote dissemination of a wide range of audio and visual materials. The third and last implication, an unresolved one, that centralization or decentralization of libraries and other varied educational media is an important consideration, suggests that each institution must make its own analysis and determine for itself which system is to be used. But there must be a system

The influence of these themes and implications can be noted in the description and presentation of plans for the Center in the following pages. They provided a basis for the following statement of objectives of the Learning Center project:

1. To create an environment most favorable to learning
2. To provide space and facilities designed for versatility and maximum utilization
3. To make available the wealth of modern resources in educational materials and aids for study of the arts and sciences
4. To encourage the student in her capacity for self-education
5. To enable the teacher to utilize his time and ability more effectively.

The next phase of planning was a study of the facilities projected by the Learning Center objectives. It was a study directed by the environmental architect, Eldridge T. Spencer, Consulting Architect to Stanford University and the National Parks Service. This phase of the study included consultation with authorities in anthropology, sociology, biology, libraries, communication and educational media.

At the conclusion of this study the College appointed Joseph D. Murphy, of the firm of Murphy and Mackey, St. Louis, a fellow of the American Institute of Architects and formerly Dean of the School of Architecture of Washington University, to develop the architectural plans for the Learning Center. Another series of conferences with faculty and administration gradually developed the specificity of space designation and design necessary for preliminary architectural drawings and finally their refinement into working drawings. Throughout this process the College's Director of Educational Development assumed the responsibility of working both with the faculty and with the architects in helping to translate educational objectives and functions into the design of space and facilities. The College's Superintendent of Buildings and Grounds, himself a civil engineer, assumed equal responsibilities, his being greater when the stage of working drawings and construction was reached. Both College representatives, however, worked constantly together with the architects during the entire process of planning and construction. Repeatedly key faculty were asked to give their reactions at pertinent points in the development of plans. This was particularly necessary in the case of the Head of the Television, Radio and Film Department who is also Director of Audio-Visual Services. His thorough familiarity with the functions which the dissemination system and educational media facilities must serve guided the design engineers in their development of integral and interrelated electronic systems.

The Learning Center, then, its concepts, plans and functions grew out of the translation, as any such project must, of the ideas and dreams of many people--administration, faculty and assisting consultants--into specific requirements and finally out of an architect's sympathetic and sensitive response to these ideas in terms of space and form and relationship.

With this background on the origin of the Learning Center, the reader may get a better sense of the Learning Center as an entity by engaging in an imaginary tour with the aid of figure 1. Building C, the center one in the cluster, is the Resources Library and sits on the highest point of ground not only of the campus, but also of the surrounding community. Approaching the Learning Center or standing within it, the visitor may be conscious of certain characteristics of the rest of the campus that the Learning Center is designed to perpetuate. One is a free flowing quality as far as space and relationship of buildings are concerned. Another is an impression of lightness rather than heavy solidity. As one looks at the Resources Library he sees that on all four walls there are pillars of white limestone and between these there is the glass of window walls, with dark opaque glass behind the pillars and soft-toned red brick on the lower level. This combination of red brick, of stone and of glass, ties in with the structural materials of the rest of the campus. Just west of the library, to the left in figure 1, is the chapel, designed by Eero Saarinen. With its completely brick walls broken only by the stained glass windows of the entrances, it forms a transition between the older part of the campus and the new James Madison Wood Quadrangle or Learning Center.

Starting from the chapel, one walks up a slight incline to the terrace or promenade that can be seen in figure 1 as a central slate-paved area joining buildings A, B and C. From this terrace one may enter building A going either directly into the Science Department or below that into the Radio, Television, Film and Audio-Visual quarters, or he may enter from the terrace directly into building B--the Communication area with the Humanities area below. Going to the east edge of the terrace and looking down to the lower level he sees the reflecting pool around the Resources Library and farther on he catches a glimpse of building D, the Fine Arts Center. Leading to it and its outside sculpture court--itself an out-of-doors classroom--he sees the bridge leading to it over the lower reflecting pool. Through the window-wall that forms the north enclosure of the sculpture court he catches a glimpse into the adjoining Art Gallery.

If the visitor were to go south on the terrace toward the street in the foreground of figure 1, and down the wide stairway to the street level, he could enter the Center between buildings A and B. Here he would come into a large completely covered area directly under the terrace above (see figure 3). It is at this level that all of the buildings in the Learning Center are joined. From this area, labeled Lobby Display, he can reach any part of the Center. Assuming that one has entered from the street and is facing forward, he can reach the

Television, Radio, Film and Audio-Visual areas and Science on his right. On his left he can reach the Humanities and Communication Departments and to the extreme left, Walter Hall, which houses the Departments of Religion and Philosophy and Foreign Languages. By going directly forward and along a long corridor he can reach the multi-purpose areas, the cinema laboratory, the ground floor of the library and the fine arts center. From this level he can go up to all levels of the library.

A visit to the top floor of the library, also to be seen in figure 1, will help to illustrate some of the objectives sought in planning. With the help of many people as consultants, the College became more sensitive to certain qualities that the campus already had. One is a characteristic which seems to fit a woman's campus in particular, an avoidance of mass movement and congestion. Students go easily from one part of the campus to another. Both within and without the Learning Center, effort was made to preserve this characteristic of openness and non-congestion. For instance, from the top floor of the library, as well as from the two floors immediately below, one can look outward through windows on all four sides. Looking toward the west, one gets a view across the center campus toward the chapel. To the east, he sees a vista across the lower part of the Quadrangle down a long hillside and on out to the College lake in the distance. To the north, from the lounge area around a sky-lighted open fireplace, he can look across the tree tops hiding the residential area below. And to the south, he looks directly down into the court which the buildings of the Learning Center form.

Descending downward from this top floor of the library he passes through open stack areas with individual study carrels, tables arranged for secluded study and informal reading areas positioned around the perimeter of the building and among the stacks. Descending into the lowest floor of the library, he sees study areas with special carrels for listening and recording, special tables for using oversized books, listening rooms for four people, again, book stacks and special areas for displaying paintings and reproductions and an informal reading-study-listening lounge that looks out across the reflecting pool into the sculpture court and beyond into the exhibition gallery.

All of these spots provide a constant variety and change of view and vistas which, it is hoped, will enhance the atmosphere for learning.

To help the reader further visualize the Learning Center as a unit of integrated facilities and to see how certain of the previously stated objectives and basic principles have been applied, several examples are given. It will be remembered that, paramount in the thinking of the College and its consultants, has been the importance of translating into plan the principle of flexibility. In anticipation of the change expected to occur in the pattern of educational needs, several spaces are designed to serve multiple purposes--designed to be used in as many ways and for as many purposes as the College's educational demands require and architectural design makes feasible.

For instance, at the center of figure 3, is an area labeled "multi-purpose room." It is a flat-floored area that can be divided by an operable or retractable wall, so constructed that it prevents normal sounds from passing through. This space can be used as two separate rooms each accommodating approximately 60 people or as one room accommodating approximately 130 to 150 people. In addition, this same space is equipped with a separate lighting system so that it can be used for theater-in-the-round. Each half of the room is equipped with audio-visual control panels designed to be connected to electronic lecterns that will permit a complete range of control of sound, light and projection by the instructor. On the same floor plan of figure 3 is the assembly hall in building A and a cinema lab in building C. These two are multi-purpose areas. The assembly hall seats 300 and the cinema lab 135. Each is equipped with electronic lecterns capable of controlling a full range of audio and visual aids to instruction. Each is useable for lectures, demonstrations, recitals and similar uses. Each has its own projection room, but that of the cinema lab serves also the adjacent multi-purpose room previously described.

The lobby display room, indicated in the lower center of figure 3, serves several purposes also. Its name indicates these in part. Being a large room, approximately 34 x 80 feet, it provides a commodious lobby when the assembly hall is in use. Its more important function, however, is to serve as an informal gallery and exhibit area to supplement the work of teaching departments, particularly in the humanities. It is designed to house special exhibits of all kinds from any departments wishing to present them. Its adjacency to the humanities instructional area immediately to the left in figure 3 makes it a readily accessible laboratory for special assignments. Just to the north of the lobby display is a classroom numbered C101. This is a primarily unscheduled classroom available for experimental purposes. It is so designed that it can also double as a greenroom when theater performances are presented in the multi-purpose room. It is also equipped with a small kitchenette unit for serving refreshments when semi-social affairs are held in the lobby or multi-purpose areas.

Another example of planning for flexibility may be noted in the design of pairs of classrooms, B105-106, figure 3 and B210-211, figure 4 (seen more clearly in the detailed drawings, figures 8 and 9). Each half of these pairs of rooms may be used as individual classrooms with the operable wall dividing them drawn. As such, each room will accommodate up to 50 students depending upon the formality of the seating arrangement. With the operable or retractable wall open, the double room will accommodate up to 100 students comfortably for joint meeting of several sections or for specially planned conferences. Again, each classroom is equipped with electronic control panel and teacher's console to permit the full range of control of lighting, sound and projection.

Another basic principle of planning was that of providing for a variety of resources and spaces. This is exemplified in several instances. Applying the principle of variety to resource materials, the College recognizes that the two very old and proven resources are books and people, but it also recognizes that today the book has taken many forms. It may be a film, a record, a soundtrack, a video tape, a slide or combination of these. The Learning Center provides for this tremendous new range of resources through the design and installation of electronic communication systems that incorporate television, radio and multiple educational media.

Again referring to figure 3 (and more clearly in figure 11), one notes in building C that space has been labeled Audio-Visual Library, Listening Carrels, Viewing and Listening Rooms. Here individual carrels will be equipped for either routine study or for use of tape recorders, permitting both recording and playback on cartridge tapes, and viewing on small individual television sets. The other usual projectors for film, film strip and slide will also be available. The listening rooms are designed for group listening of four people each and are provided with stereophonic equipment.

Variety in sizes and uses of space is also incorporated. Figure 4, building C (also figure 14) shows rooms C208-216 which are faculty offices serving also as seminar rooms where much of the literature is taught. In figure 4, building C, level 4 (and in figure 15), one can see the conference rooms C313-314 and the study lounge C308. These accommodate small, medium and large groups for conference or study. Figure 4, building D, rooms D201-206 are rooms which double as offices and faculty art studios. All of the other offices will also accommodate seminar-sized groups of students, usually four or five, but in some instances, as many as eight to ten. The typical classroom will accommodate up to 50 students depending upon the manner of arranging seating. The double rooms are large enough for 100 students, thus permitting the combining of classes. The assembly hall seats 300, the cinema, 135, the combined multi-purpose rooms, 150. Elsewhere on campus there is an older auditorium which will accommodate 650 and a large assembly hall seating 3000. By providing spaces to accommodate this range of numbers, the College hopes that it is making possible an optimum range of teaching situations adaptable to many techniques.

The basic principles of ready availability of materials and close proximity of materials, spaces and people were constantly in mind as the two previous principles of flexibility and variety were observed. Availability and proximity are best evidenced as one visualizes how a student may move from a faculty member's office to a classroom--both of which are filled with resources and aids--into a corridor which contains learning materials mounted on the display walls, into such areas as the lobby display, library, sculpture court, and art gallery, to the out-of-doors, which is also a laboratory where trees and shrubbery carry appropriate name tags.

Throughout this description of the Learning Center facilities there has been repeated reference to the provisions for educational media, the systems and equipment necessary and the uses to which these are put. The importance of this part of the design and its potentialities for future experimentation and utilization cannot be over-stressed. Provision for optimum use of educational media was basic in the very earliest thinking about the Learning Center. The importance of this provision was emphatically stressed in the New Frontiers in Learning conference. Its justification for inclusion has been amply supported by the increasing application of educational media in higher education. These facilities in the Learning Center are well described by the Head of the Department of Television, Radio and Film who is also Director of Audio-Visual Services.[1] In the following description the reader should refer to figures 3 and 4 which show the relationship of all parts of the Learning Center and to figures 5 and 6 which show in detail the floor plans of the television, film and audio-visual facilities.

"Heart of the Learning Center is a dissemination system designed to provide for maximum transfer of information to or from the various spaces and the central information storage in building A. A two-inch conduit system containing two coaxial cables ties together all learning spaces from individual seats to large areas and includes exhibition corridors, lobbies, exhibit areas, classrooms, residence halls, radio studios, television studios and their control rooms. The new system will connect with the existing closed-circuit system. The coaxial cables and shielded audio pairs will enable simultaneous transmission of a minimum of seven video channels, 25 FM stereo or 50 FM standard audio channels, and numerous additional telephone circuits if needed. Information, both recorded and pictorial, can be sent from central storage to each of the points in the system, and from these points back to central storage. Areas can also be isolated for special interconnections. The two-inch conduit is supplemented by other smaller conduit systems connected to the main system. Conduits in the Learning Center can be likened to arteries and veins in the human body. If central storage is considered the heart, then the two-inch conduit becomes the arteries and veins pumping information to and from it. Smaller conduits are capillaries performing such functions as remote control of lighting, projection, sound and recording.

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[1] Balanoff, Neal, "James M. Wood Learning Center, A Saturation Experiment at Stephens College," Audio-Visual Instruction, April 1963.

"Instructor consoles in each of the classrooms in the Humanities and Communication areas, in the cinema-lab, and in the assembly hall have mechanisms for remote operation of film, slide and filmstrip projectors, TV receivers and record and tape playback systems. These consoles also control lighting.

"The entire floor of level 2, building C, Library (see figure 3), is a network of ducts to enable installation of equipment as needs expand. Individual study spaces and listening and viewing spaces equipped with headphones and various types of audio-visual equipment are located on this floor. In this system the individual instructor or the student is the brain that commands the electronic devices, that places program information into the system, that decides when, what, and how a function shall be performed....

"Although programming can be originated from any point on the coaxial system, most of the information will be disseminated from Building A which houses the television and radio studios. For the past eight years the College has experimented with instructional uses of closed-circuit television. Industrial cameras, then studio vidicon cameras, were used. Up to now, one small studio has provided live programming and film distribution on two channels to 70 locations in classrooms and dormitories. The new Learning Center contains two television studios (one 40' x 50' and one 30' x 40'), with control rooms, large master control area, and storage spaces. (See figure 5, level 1.) Master control has been planned for eventual accommodation of color, six film chains, two tape or film recorders, and microwave or 2,000 megacycle relay. A second area for maintenance can also serve as an extension of master control. Two radio studios will provide audio dissemination; open circuit FM radio transmission as well as stereophonic recording and reproduction are also in the plans. All audio and video facilities can transmit or receive from individual study spaces. In addition to FM lines, telephone lines are provided in the event that a system utilizing dial telephone equipment for retrieval of information is required. A film production studio, film editing area, and still photography studio are located on level 1 (see figure 5, A32). Located on level 2 (see figure 6) are faculty and staff offices for the Audiovisual Center and the Television, Radio and Film Department. A graphic arts studio and a faculty materials preparation center are incorporated into the complex (see figure 6, A114-115)."

Figures 5 and 6 also show the plan of the assembly hall, A104. This is the versatile teaching auditorium designed to accommodate an optimum range of educational media for a variety of kinds of presentation. (Its facilities are also duplicated in the smaller cinema laboratory, C110, figure 11.)

Its stage has three positions for an electronic lectern--right, left and center. From these positions the lecturer can control sound--monophonic or stereophonic, recorded or live; lighting; projection of film--single slides, or multiple slides simultaneously, strip film or overhead projection image. Large screen television projection is available from portable, studio or previously taped sources.

Although not wired as yet, conduits to each row of seats permit future installation of an individual response system at each seat.

The assembly hall is designed to accommodate audiences and classes of up to 300. Its acoustics have been carefully planned. Its carpeted floor, upholstered seats, low level lighting and pleasing decor are intended to provide a pleasing and highly versatile setting for teaching and learning as well as for the enjoyment of some performance arts.

Figure 7 shows the arrangement of the facilities for science laboratories and mathematics. Since the laboratories are located above the assembly hall and TV studios, there is a double floor construction of two slabs of concrete with the utilities placed between them. This is to assure sound isolation from the spaces below. The utilities are accessible through removable floor panels in the laboratories.

Laboratories A203-207, although presently assigned to botany, zoology and biology can be used interchangeably with minor modifications. Among them there is a variety of arrangement of equipment--a perimeter placement of laboratory tables, an island arrangement and a peninsular arrangement. The first two are used also in the two chemistry laboratories, rooms A208 and A209.

Figure 7, rooms A211 and A213 show classrooms presently equipped for mathematics classes. Instructional walls permit ample chalkboard and display surfaces. The teaching wall is equipped with sliding chalkboards, television outlet and projection screen. Both rooms are carpeted.

Room 210 is a lecture room which will accommodate 70 students. It contains a stationary demonstration desk, a pass-through window into the chemistry laboratory just behind it, a connection to the fume hood in the laboratory, sliding chalkboards, provision for television reception and origination and remote control of projection equipment.

Faculty offices, project and preparation rooms are located on either side of the corridor and are accessible from the corridor, classrooms or both. Included in the plan is a controlled environment room permitting control of light, temperature, humidity and gases. Some space is designed for use either as office or mathematics laboratory. Office A210, with windows on the exterior wall and also facing the interior corridor, is equipped for the display and maintenance of plants since it is adjacent to the botany laboratory. It thus presents an interesting visual display to the passers-by.

Laboratories are equipped to receive or originate television. Provision is also made for moving portable demonstration tables and equipment down the elevator to the assembly hall when larger groups are desired or a more complete range of educational media is to be employed.

Figures 8 and 9 indicate the design of the instructional space for humanities and English (Communication). Most particular to note is the arrangement of offices and classrooms. The offices are arranged in clusters and as previously stated, of such a size as to permit seminar sessions. The clusters were chosen for their privacy and for more economical use of space. Further, they could be converted into an additional classroom if the spaces were combined. Their adjacency to the classrooms and to the multi-purpose areas, hopefully will encourage a wider variety of methodology.

In building B (figures 8 and 9), the typical classroom is equipped with instructional walls. These permit the mounting of any amount of chalkboard, tackboard or shelving, on metal standards sunk into the plaster. Built into the front of the room are stereophonic speakers, a television set hanging from the ceiling and a projection screen. These are all positioned near the corridor side of the room which is considered to be the teaching wall, although other positions for teaching may be used. Provision is made for placing projection machines for slides, film and filmstrips at the rear of the room. All of the electronic equipment in the room, including three-level room lighting, may be operated from the teacher's console. This is a specially designed desk whose electronic controls are plugged into an audio-visual electronic control panel mounted on the wall. These controls give access to the materials coming over audio or visual channels from the central control area in the Television-Radio-Film center. To complete its furnishings the typical classroom is equipped with audio-visual blinds. Three of the classrooms on each floor of building B are carpeted, again to allow for variety and experimentation. Both sides of the corridors in this building are equipped with instructional wall mounts and with fabric-covered wooden panels so that there is a maximum of space for the display of supplemental instructional materials.

Figure 10 will help the reader to visualize the relationship of the multi-purpose area which joins buildings A, B and C at level 2 below the open promenade or terrace. He will note from this picture that the entrances to the Center are clearly at two different street levels and that there are several into the group of buildings rather than one main entrance. This again illustrates the planning for easy accessibility to the materials and spaces for learning.

Figure 11 reveals in greater detail the relationship of some of the multi-purpose areas to the lowest level of the library.

Figure 12 features the central building of the group, the Resources Library.

Figures 13-16 show in detail the variety and placement of stacks, seating and study arrangements in the library. Figure 13 is of particular interest since this ground floor of the library is the one which is completely underlaid with a network of conduits which will permit installation of any foreseeable electronic device that may prove advantageous in the future. In the extreme upper left hand corner of figure 13 is the Acquisition Department of the library. At the top of the diagram in the right hand portion of figure 13, opposite from the Acquisition Department is the row of six listening rooms, designed to accommodate four students each. In the upper left hand corner of this same portion of figure 13 is the area containing audio-visual carrels. Immediately behind the charging desk is a console similar to that in language laboratories which will permit the librarian to schedule group listening as well as individual. Some of the tables in the upper half of this same section will also be equipped for individual listening, through ear phones. The carrels which are arranged around the lower perimeter of figure 13 are designed to serve a dual purpose. Early in the fall of each year they serve as display panels for an extensive collection of prints. These prints are for students to check out for personal use in their dormitory rooms. When most of the picture collection has been issued, these are then converted into individual study carrels. Large study tables accommodating 4 persons each and placed among the stacks in the lower section of the floor plan are specially designed to permit elevation of each section of the table to a height and pitch to accommodate over-sized books, such as art books, for more convenient study by their users. The lower right hand group of chairs are for automated programmed learning by groups. Visual material with accompanying recorded lecture commentary is presented on a rear view screen and through individual earphones to several students simultaneously. In the upper right hand corner of figure 13 is the concert and reading lounge, furnished informally for study and leisure reading and for listening to scheduled concerts of recorded music and drama. It looks directly into the sculpture court surrounded by the art center.

Figure 14 shows the arrangement of the main floor of the library entered directly from the open terrace above the multi-purpose areas. The reader can easily locate the charging desk in the left center of the figure and the reference area directly beyond. This reference area is the only place in the library where provisions have been made to seat a significant number in one area (47 in this area).

Throughout the rest of the library a concerted effort has been made to give seating as much privacy as possible by placing carrels in groups, tables among the stacks, as in the right portion of this figure, and around the perimeter of the library with stacks serving as partitions.

Also in figure 14 the reader will note the row of offices around the upper right-hand perimeter. These are the office and seminar rooms of the literature faculty and are immediately adjacent to the literature collection in the stacks on this floor. These offices are approximately 13 feet square with one wall equipped with instructional wall mounts so that chalkboard, tackboard, shelves and similar equipment may be added.

Figure 15 shows in greater detail the arrangement of the conference rooms and reading lounge. The former, situated on the extreme right wall of the building, is equipped with a folding partition. This enables the room to be used by two smaller groups or one large group. This floor illustrates particularly well the provision for secluded study areas by an ingenious stack arrangement.

Figure 16 illustrates the expected use of the top floor of the library. The left hand portion is informally furnished for reading, seminar, conference or study with groupings of furniture around an open fireplace and around the exposed window walls. Just to the right of this area is a folding partition for dividing the floor into two separate areas. The right hand area is designed for flexible use--as conference space, class sessions in the library, special exhibit and reading areas. To serve the less formal functions better, as in the case of day-long conferences, it is equipped with its own kitchenette unit. This floor of the library is intended to give faculty and students an area for quiet retreat.

Figures 17 and 18 show in some detail the studios provided in the Fine Arts Center, building D. Figure 17 shows the position of the exhibition art gallery, which is accessible from the sculpture court, from the library and from the surrounding studios. It is designed to be integral with the sculpture court.

Figures 19-22 present the interior arrangement of the remodeled Walter Hall planned by Shaver and Company, Architects. It has been integrated in plan and joined physically to the Learning Center Quadrangle proper, as can be seen by referring to figures 1, 3 and 4. Although this building is connected electronically through the coaxial cable system to the Learning Center, its classrooms are not as completely equipped electronically as those in the Learning Center itself.

The interior spaces in Walter Hall are particularly important to note because they represent ingenuity on the part of the architect in overcoming the structural handicap of pillars which could not be removed. The chief problem was to get adequate classroom and office space out of the confines of the building itself. A study of the floor plans, particularly in figures 19, 20 and 21 indicates clearly how this has been achieved.

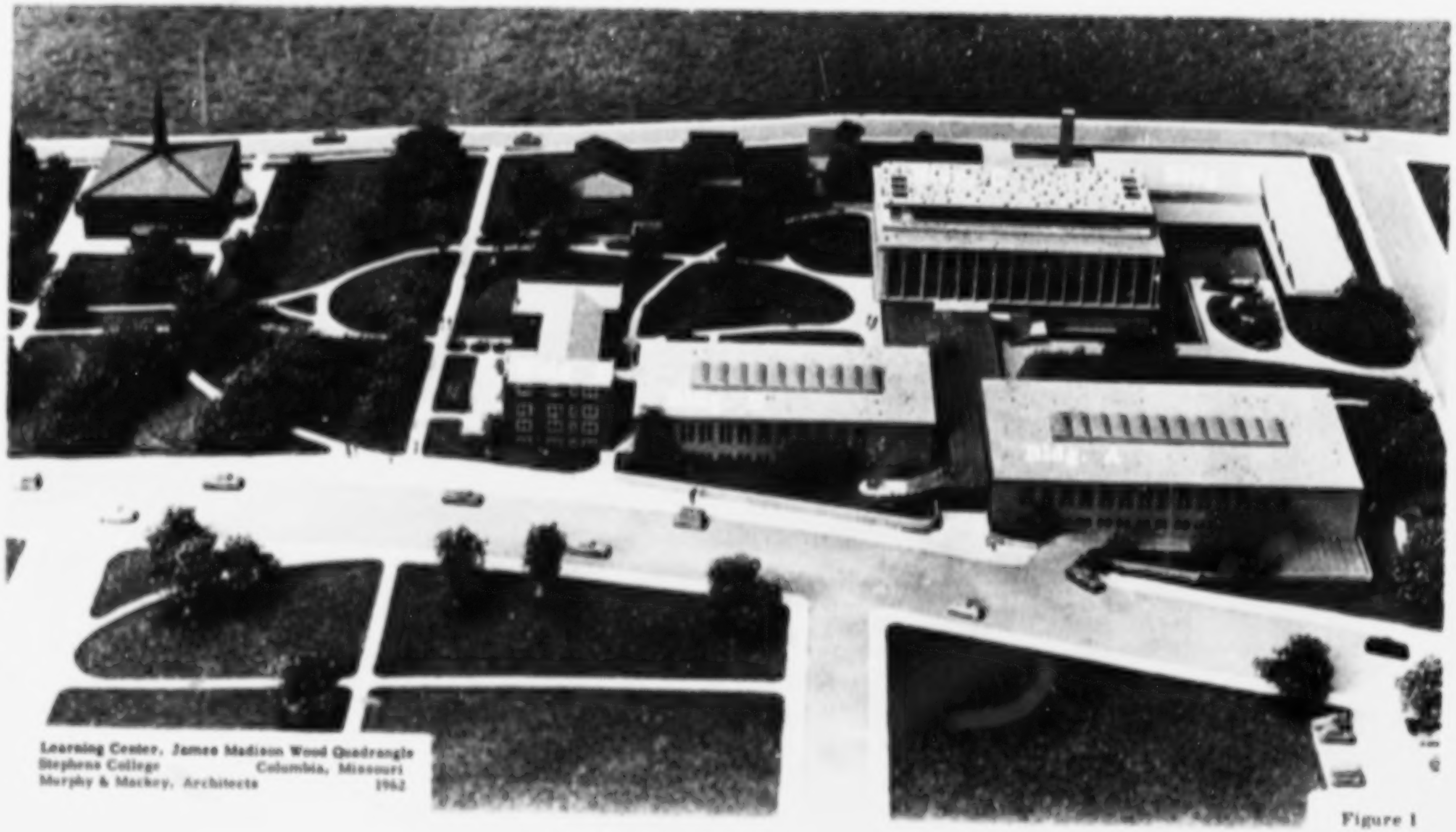
The design of the language laboratories, figure 22 (used also as the learning laboratories for other departments), is also of particular significance. The design demonstrates what can be accomplished in an older building not originally designed for such facilities. The central language laboratory accommodates 32 booths, each equipped for listening, recording and playback. The smaller laboratory is equipped with 28 booths for audio-active listening. All have transistorized equipment.

The control room for the two laboratories is labeled "workroom" in figure 22. It contains consoles for the two laboratories, projection equipment for visuals and shelves and cupboards for storing tapes and records. Visual projection into each laboratory is by means of rear-view screens. The two adjacent small rooms labeled "records" are sound recording rooms for the making of tapes. The laboratory installation is so designed that future connection with the central dissemination area of building A can be achieved through conduits provided in the remodeling.

The total design of the Learning Center represents the attempt by one college to achieve flexibility in design of space so that it may be used for many purposes; to provide a variety of learning resources and of sizes and types of space for various educational purposes; it provides close proximity among the spaces, resources and persons working together for teaching and learning; it makes possible easy availability of all of the resources which demonstrably improve the educational process.

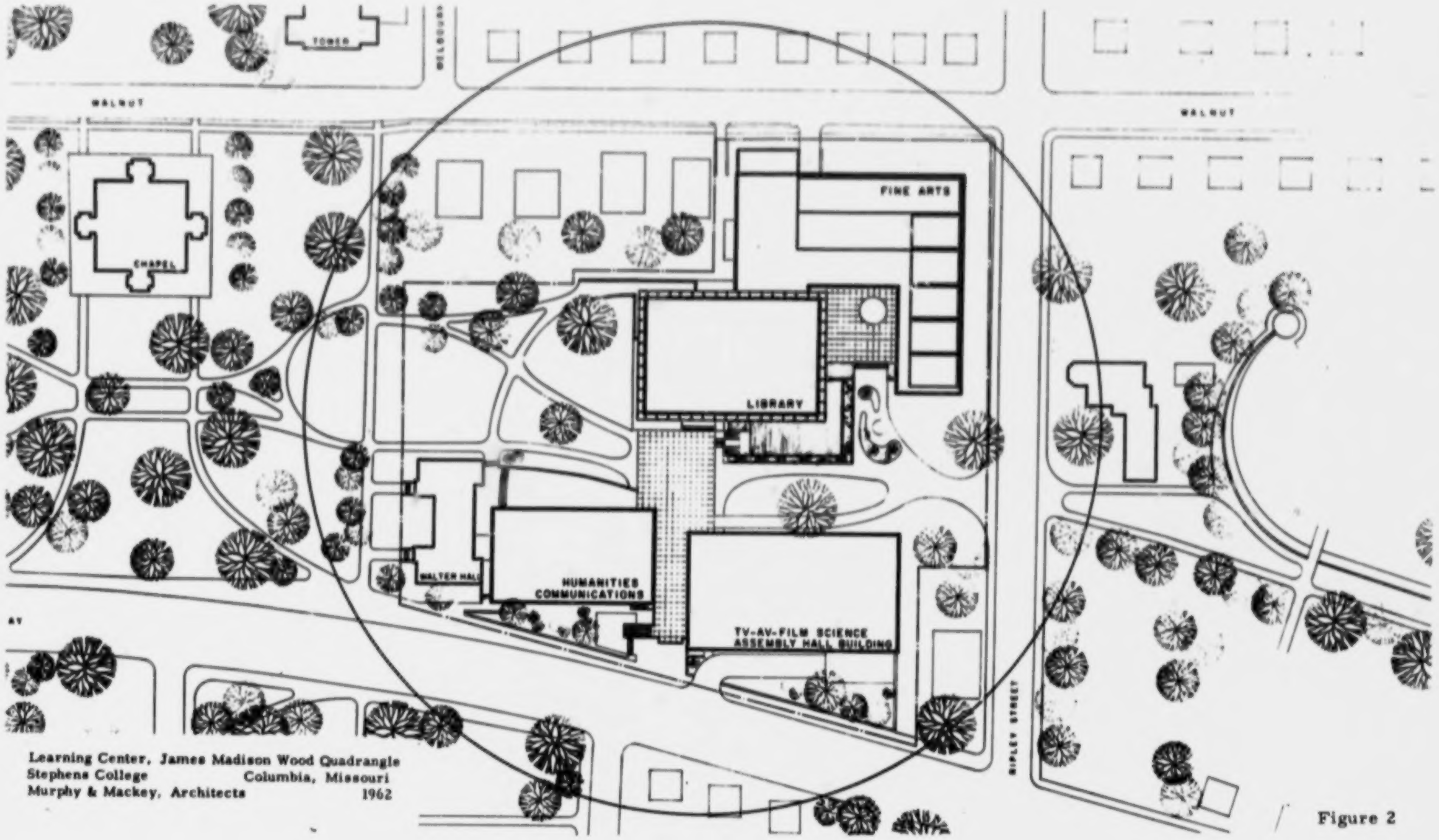
At its core, the Learning Center has a library for books and other educational media. Its buildings are connected not only physically but also through an electronic system capable of using audio and visual aids from television, radio and the whole range of educational media. It contains a range of sizes of spaces for varying purposes. It provides a setting that can encourage new and varied approaches to teaching and learning. It is adaptable to teaching for a variety of outcomes--dispensing information, interpretation of ideas, exchange of thought, articulation of knowledge, and the involvement of student and teacher alike in the application of knowledge. It provides for optimum use of existing technology useful to higher education as well as that which may be developed in the future.

The Learning Center provides for Stephens College both an opportunity and a challenge--an opportunity to demonstrate that education can be made more effective with more modern facilities and a challenge to try new patterns of teaching and learning.



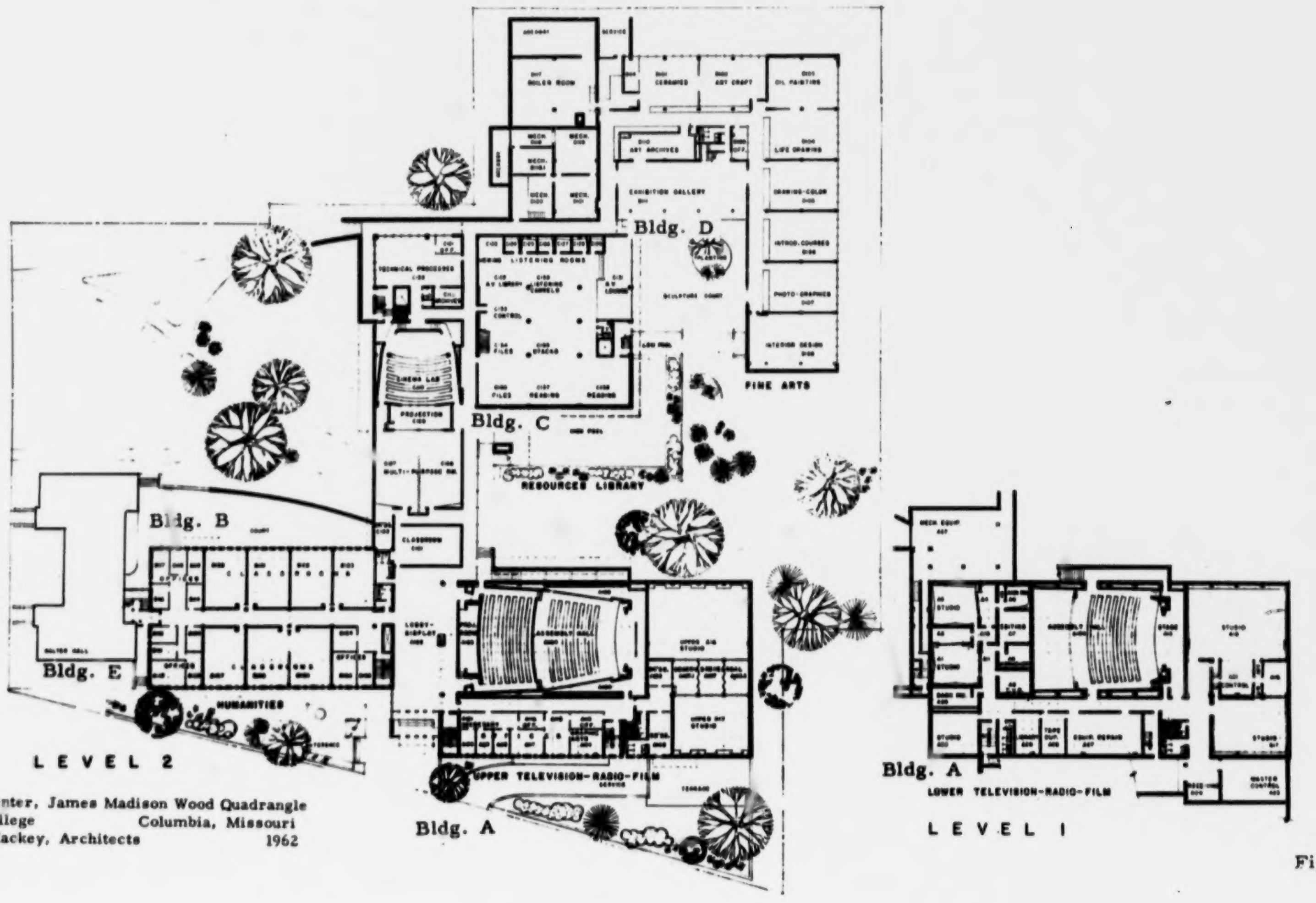
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 1


TOWER
MELBOURNE
WALNUT
WALNUT
CHAPEL
FINE ARTS
LIBRARY
WALTER HALL
HUMANITIES
COMMUNICATIONS
TV-AV-FILM SCIENCE
ASSEMBLY HALL BUILDING
RIPLEY STREET

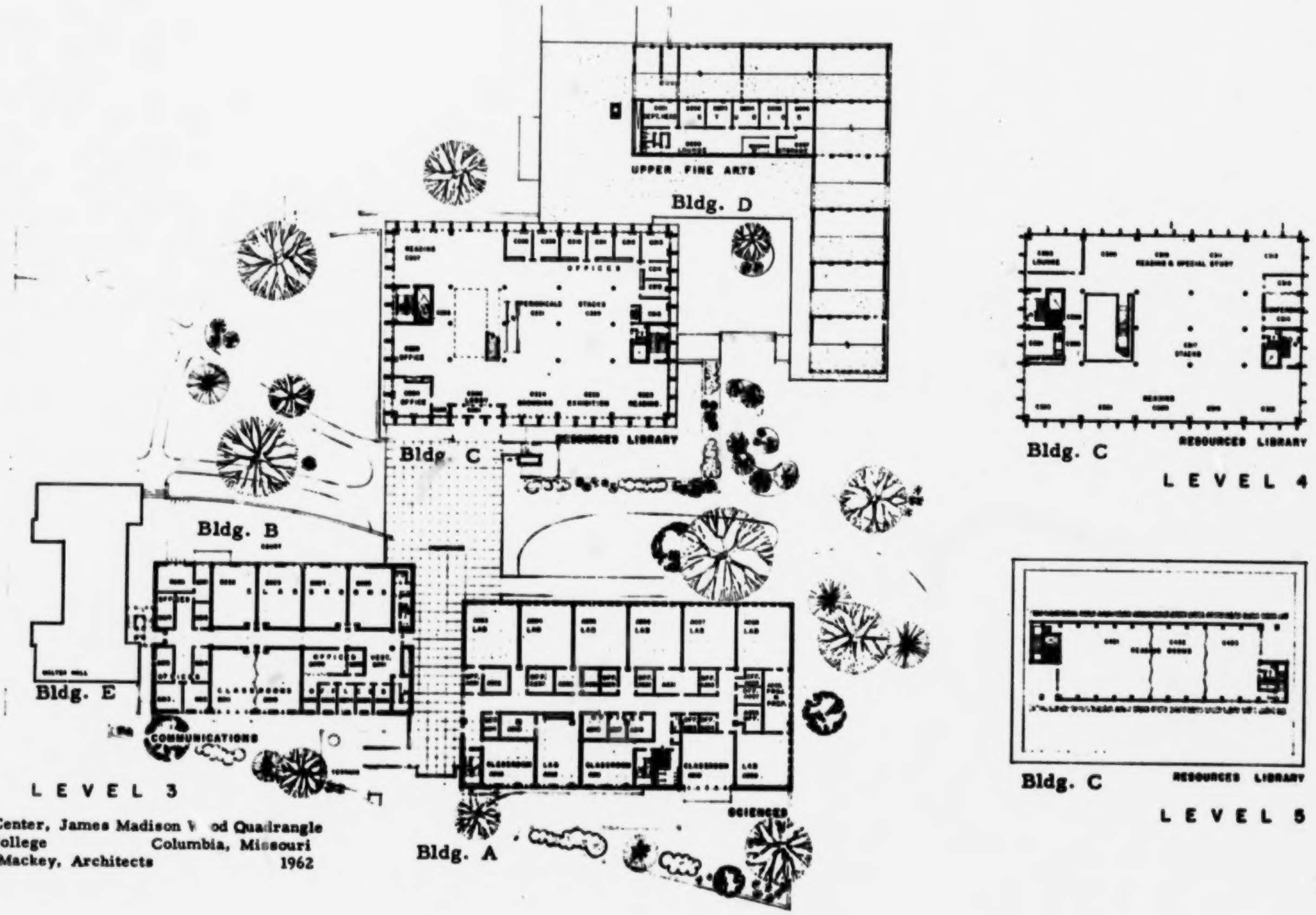
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 2


SERVICE
BOILER ROOM
MECH.
CERAMICS
ART CRAFT
OIL PAINTING
ART ARCHIVES
OFF.
LIFE DRAWING
EXHIBITION GALLERY
DRAWING-COLOR
Bldg. D
PLANTING
INTROD. COURSES
SCULPTURE COURT
PHOTO-GRAPHICS
INTERIOR DESIGN
FINE ARTS
TECHNICAL PROCESSES
LISTENING ROOMS
A.V. LIBRARY
LISTENING CARRELS
A.V. LOUNGE
CONTROL
FILES
STACKS
READING
CINEMA LAB
PROJECTION
Bldg. C
MULTI-PURPOSE RM.
RESOURCES LIBRARY
CLASSROOM
Bldg. B
COURT
OFFICES
CLASSROOMS
Bldg. E
HUMANITIES
LOBBY-DISPLAY
ASSEMBLY HALL
UPPER AM STUDIO
UPPER FM STUDIO
TERRACE
UPPER TELEVISION-RADIO-FILM
SERVICE
Bldg. A
LEVEL 2
MECH. EQUIP.
STUDIO
EDITING
ASSEMBLY HALL
STAGE
STUDIO
CONTROL
STUDIO
TAPE DUP.
EQUIP. REPAIR
STUDIO
MASTER CONTROL
Bldg. A
LOWER TELEVISION-RADIO-FILM
LEVEL 1

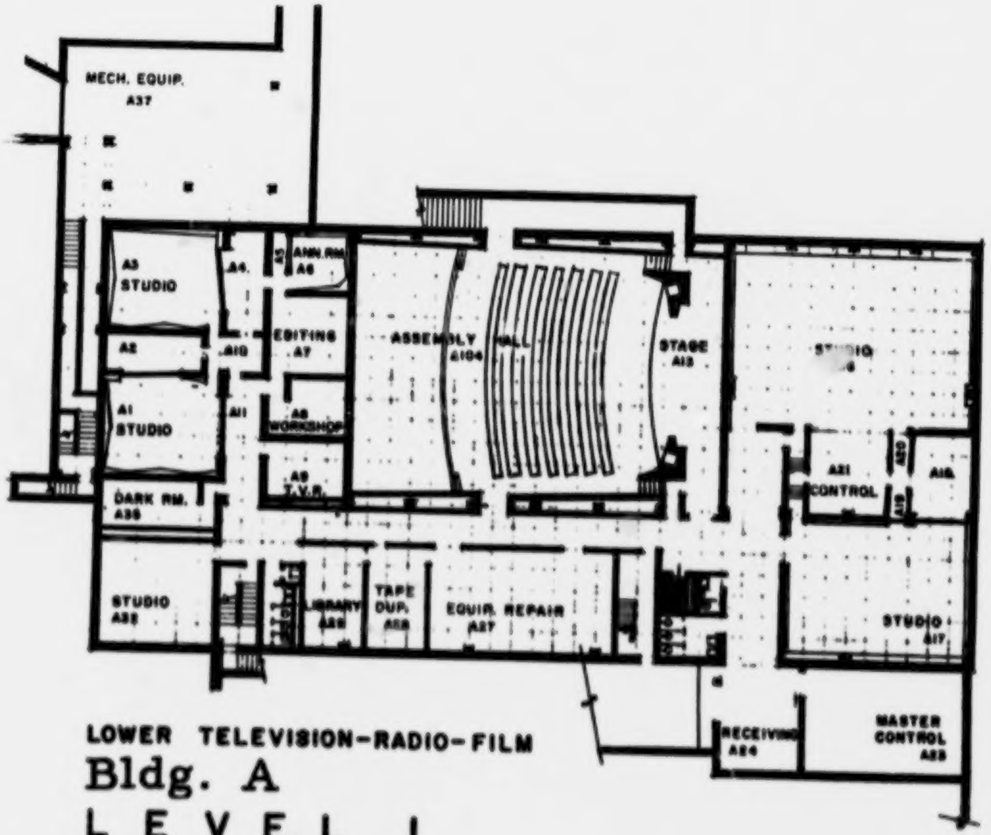
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 3


UPPER FINE ARTS
Bldg. D
OFFICES
STACKS
RESOURCES LIBRARY
Bldg. C
Bldg. B
Bldg. E
COMMUNICATIONS
CLASSROOMS
SCIENCES
Bldg. A
LEVEL 3
Bldg. C
RESOURCES LIBRARY
LEVEL 4
Bldg. C
RESOURCES LIBRARY
LEVEL 5

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

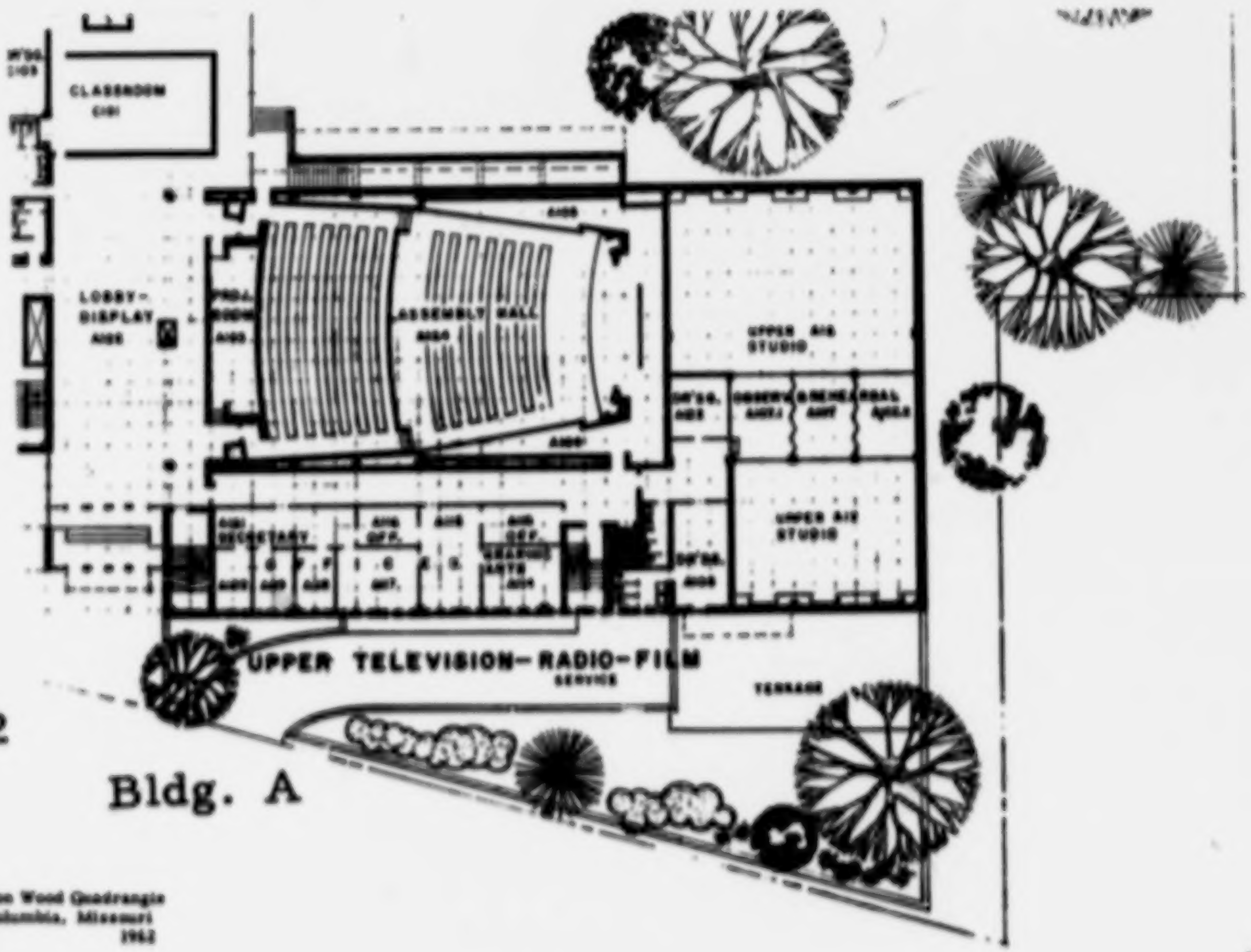
Figure 4


MECH. EQUIP.
A37
A3
STUDIO
A4.
A5
ANN. RM.
A6
EDITING
A7
A2
A10
A1
STUDIO
A11
A8
WORKSHOP
A9
T.V.R.
DARK RM.
A35
ASSEMBLY HALL
A104
STAGE
A13
STUDIO
A21
CONTROL
A20
A19
A18
STUDIO
A33
LIBRARY
A29
TAPE
DUP.
A28
EQUIP. REPAIR
A27
STUDIO
A17
RECEIVING
A24
MASTER
CONTROL
A23

LOWER TELEVISION-RADIO-FILM
Bldg. A
LEVEL I

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 5

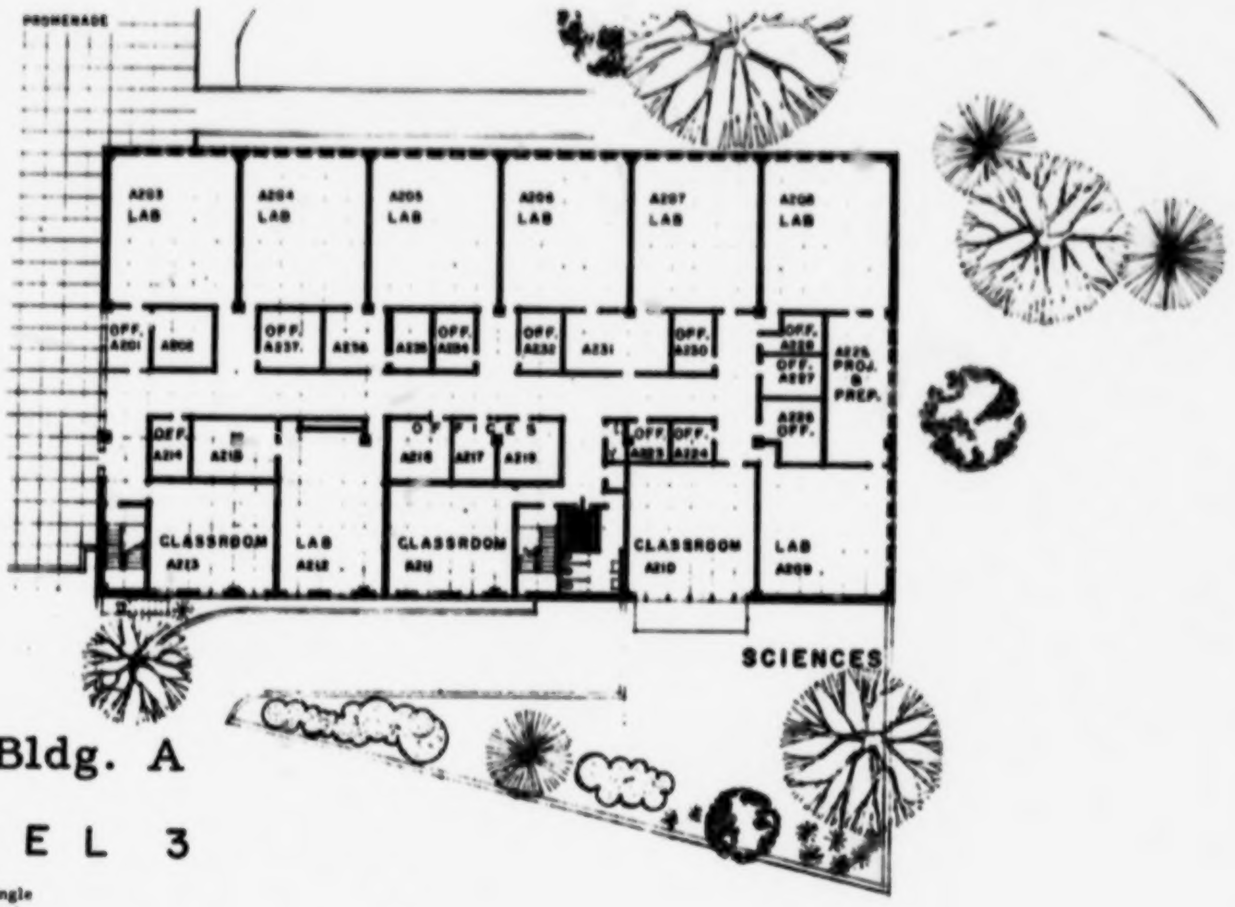

CLASSROOM
LOBBY-DISPLAY
ASSEMBLY HALL
SECRETARY
UPPER AIR STUDIO
UPPER AIR STUDIO
UPPER TELEVISION-RADIO-FILM
SERVICE
TERRACE

LEVEL 2

Bldg. A

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 6

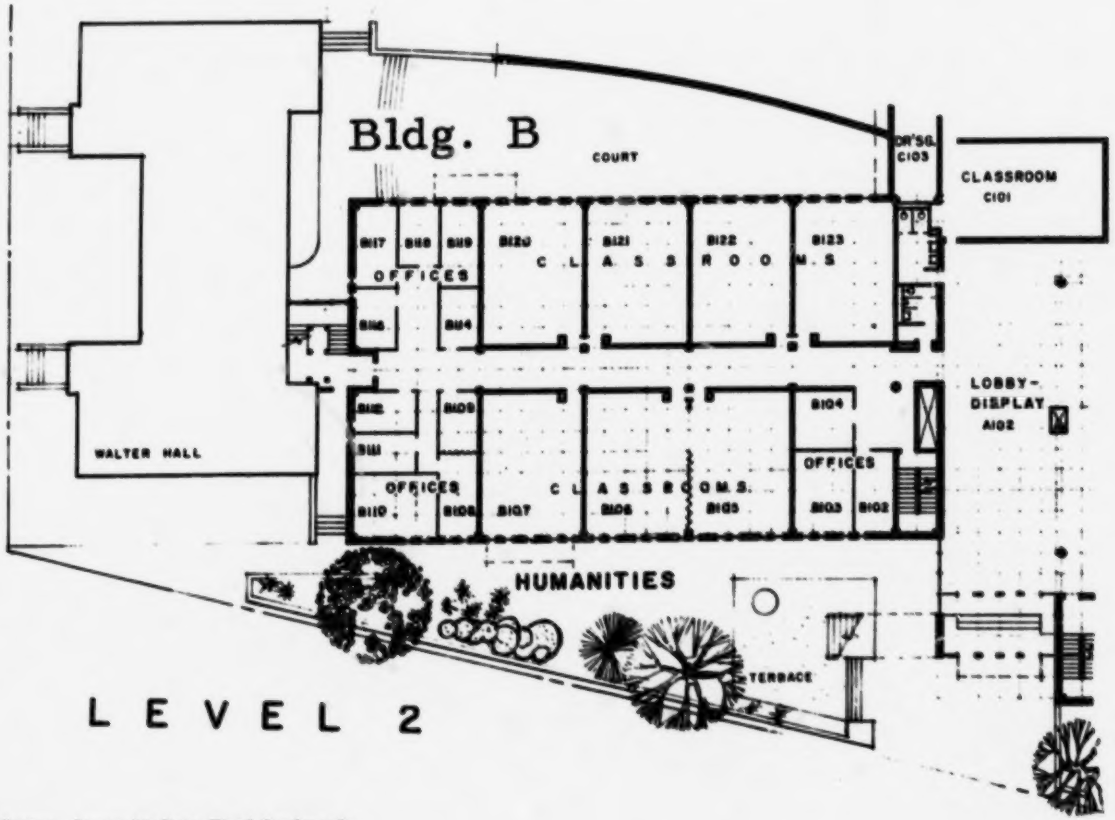

PROMENADE
A203 LAB
A204 LAB
A205 LAB
A206 LAB
A207 LAB
A208 LAB
OFF. A201
A202
OFF. A237.
A236
A235
OFF. A234
OFF. A232
A231
OFF. A230
OFF. A229
OFF. A227
A225 PROJ. & PREP.
A226 OFF.
OFF. A214
A215
OFFICES
A216
A217
A218
OFF. A223
OFF. A224
CLASSROOM A213
LAB A212
CLASSROOM A211
CLASSROOM A210
LAB A209
SCIENCES

Bldg. A

LEVEL 3

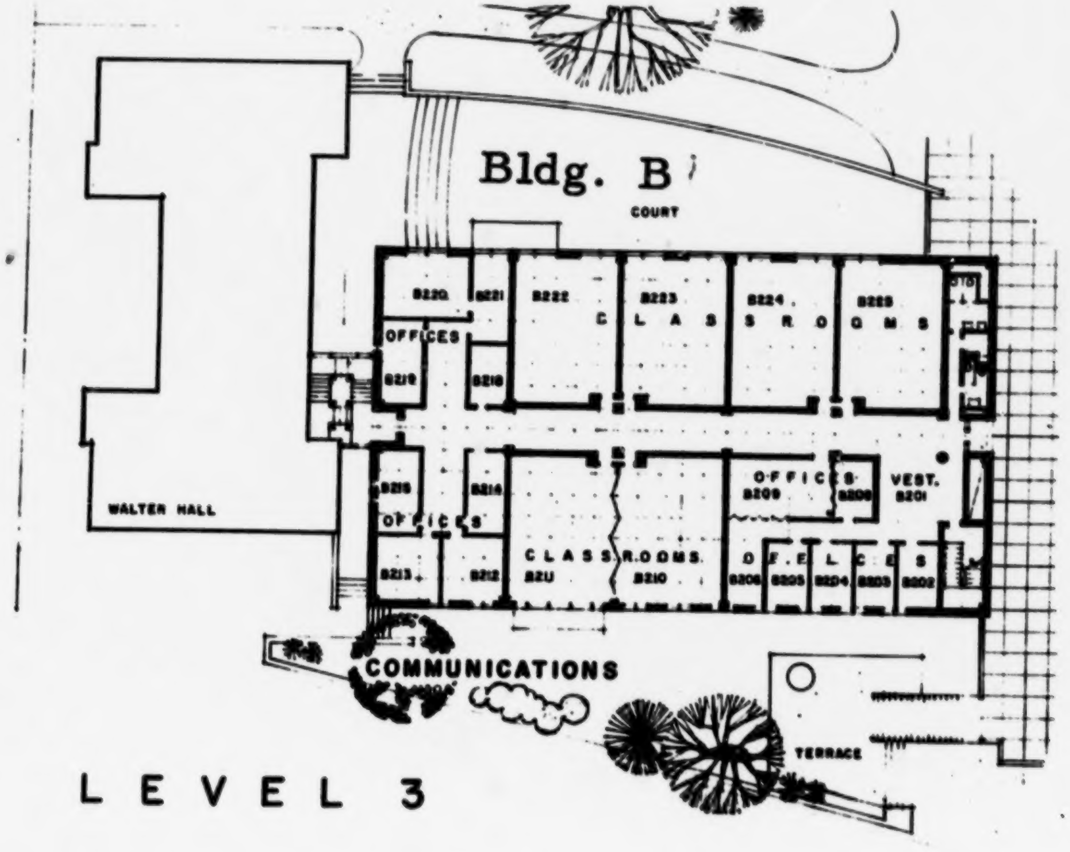
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 7


Bldg. B
COURT
DR'SG.
C103
CLASSROOM
C101
B117
B118
B119
B120
B121
B122
B123
C L A S S R O O M S
OFFICES
B116
B114
LOBBY-
DISPLAY
A102
B112
B109
B104
B111
OFFICES
OFFICES
C L A S S R O O M S
B110
B108
B107
B106
B105
B103
B102
WALTER HALL
HUMANITIES
TERRACE
LEVEL 2

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

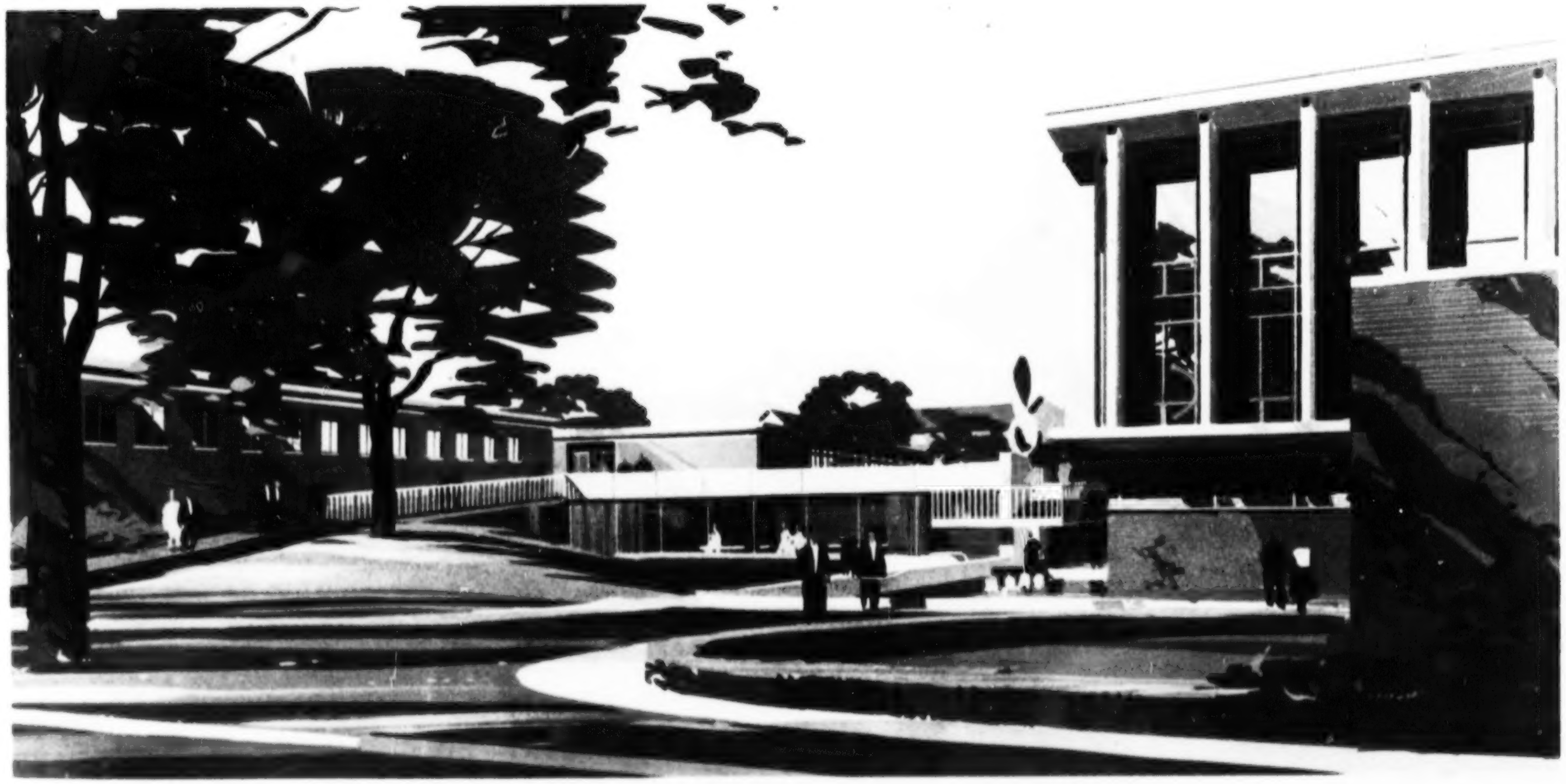
Figure 8


Bldg. B
COURT
B220
B221
B222
B223
B224
B225
CLASSROOMS
OFFICES
B219
B218
STO
B215
B214
OFFICES
B213
B212
B211
B210
CLASSROOMS
OFFICES
B209
B208
VEST.
B201
OFFICES
B206
B205
B204
B203
B202
WALTER HALL
COMMUNICATIONS
TERRACE

LEVEL 3

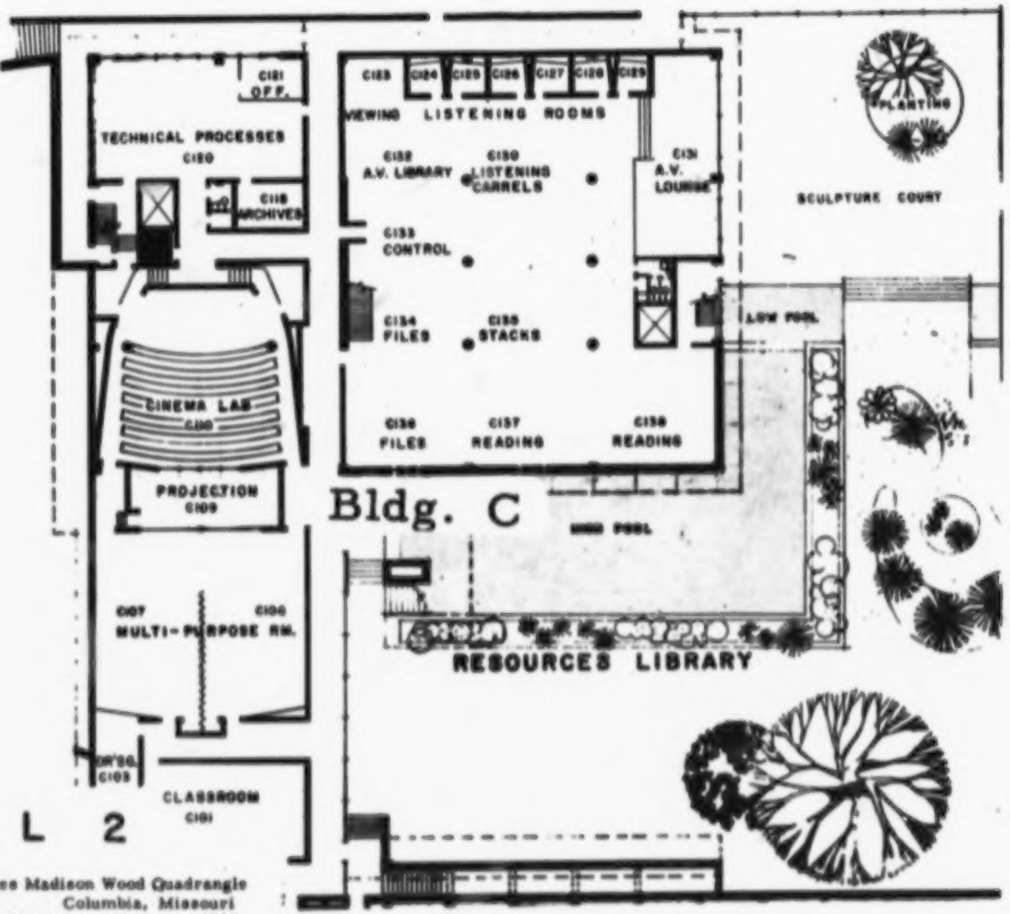
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 9



Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

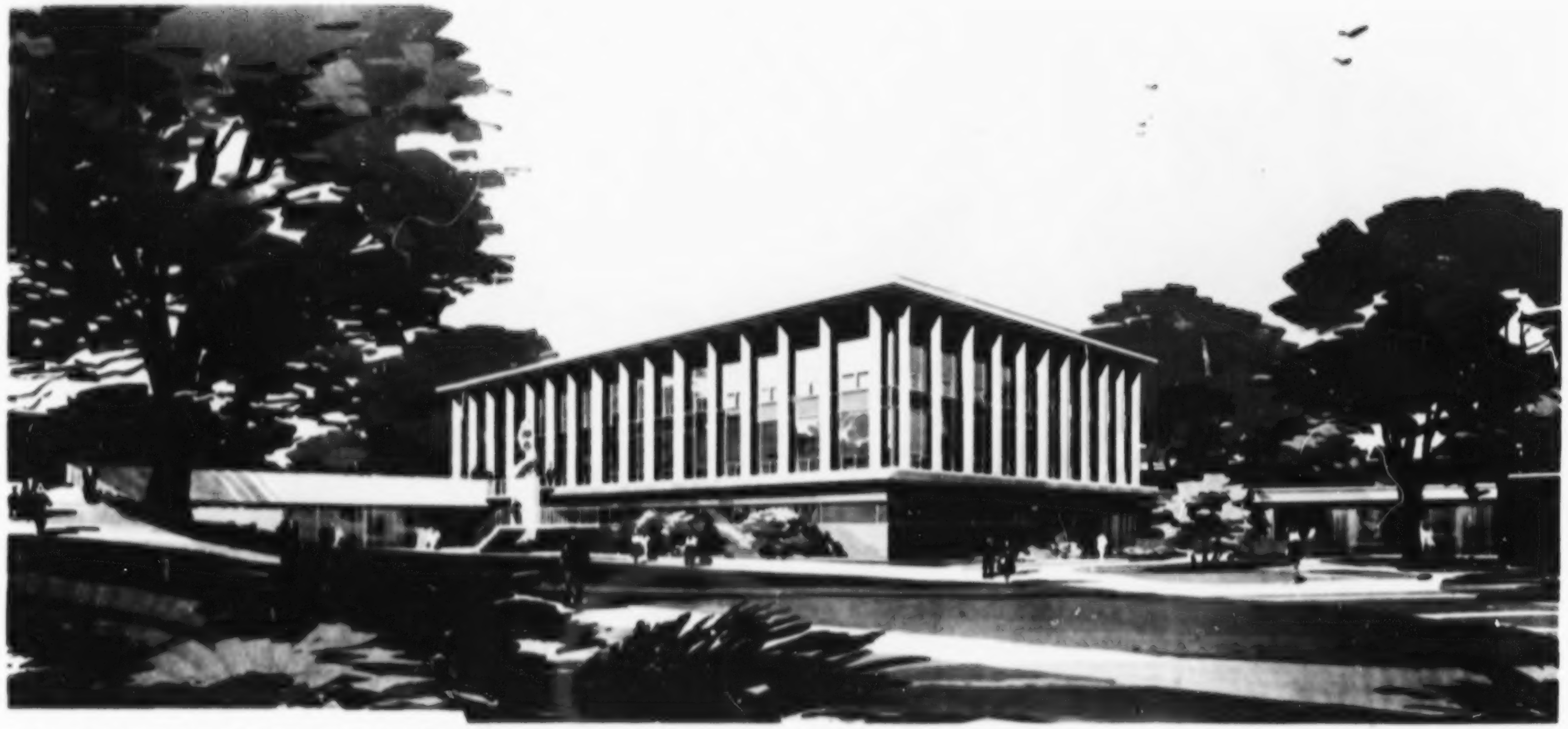
Figure 10


C121 OFF.
TECHNICAL PROCESSES C120
C119 ARCHIVES
CINEMA LAB C110
PROJECTION C109
C107 MULTI-PURPOSE RM. C106
DR'SG. C103
CLASSROOM C101
C123 VIEWING
C124 C125 C126 C127 C128 C129 LISTENING ROOMS
C132 A.V. LIBRARY
C130 LISTENING CARRELS
C131 A.V. LOUNGE
C133 CONTROL
C134 FILES
C135 STACKS
C136 FILES
C137 READING
C138 READING
Bldg. C
LOW POOL
HIGH POOL
PLANTING
SCULPTURE COURT
RESOURCES LIBRARY

L E V E L 2

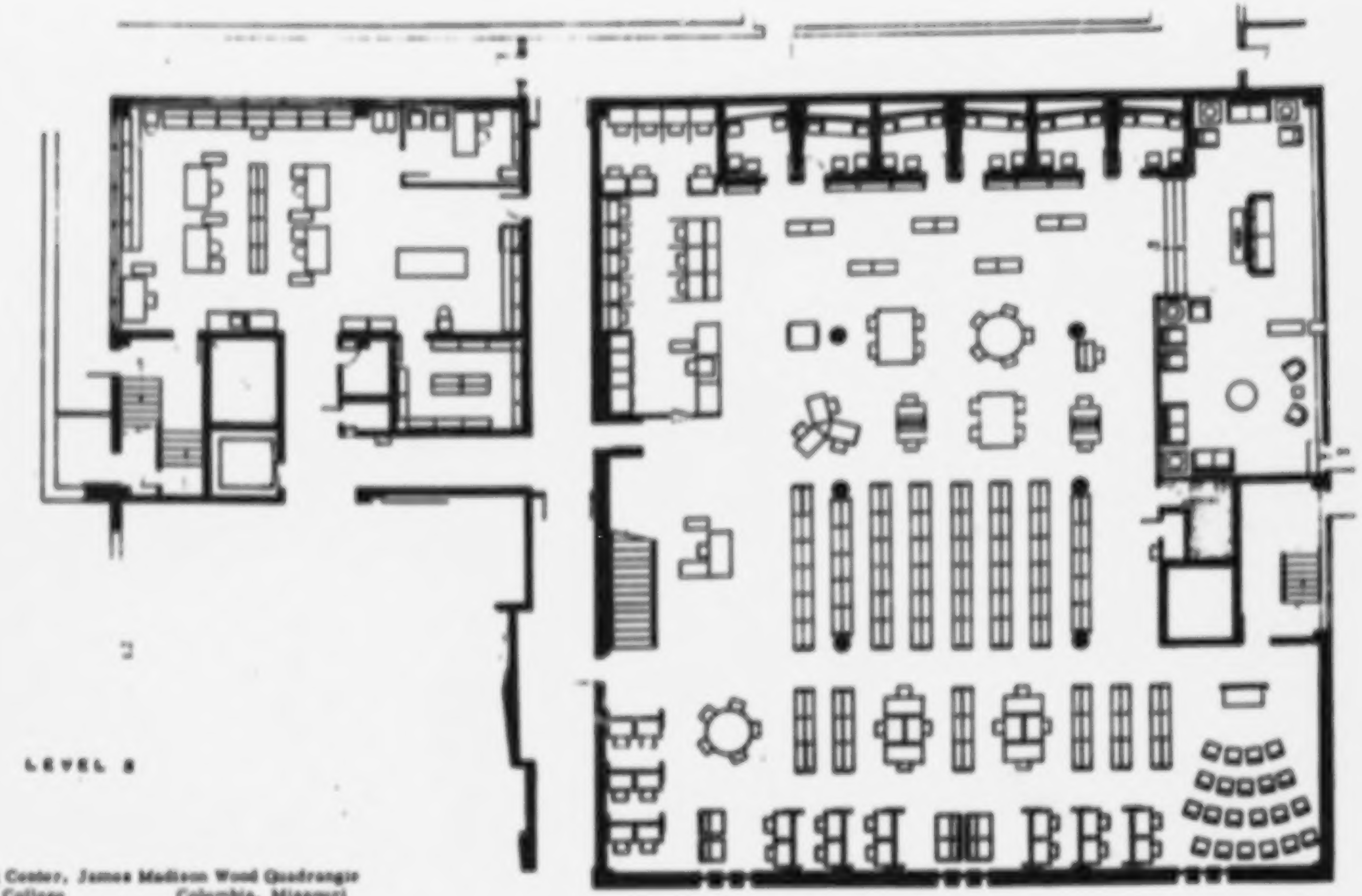
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 11



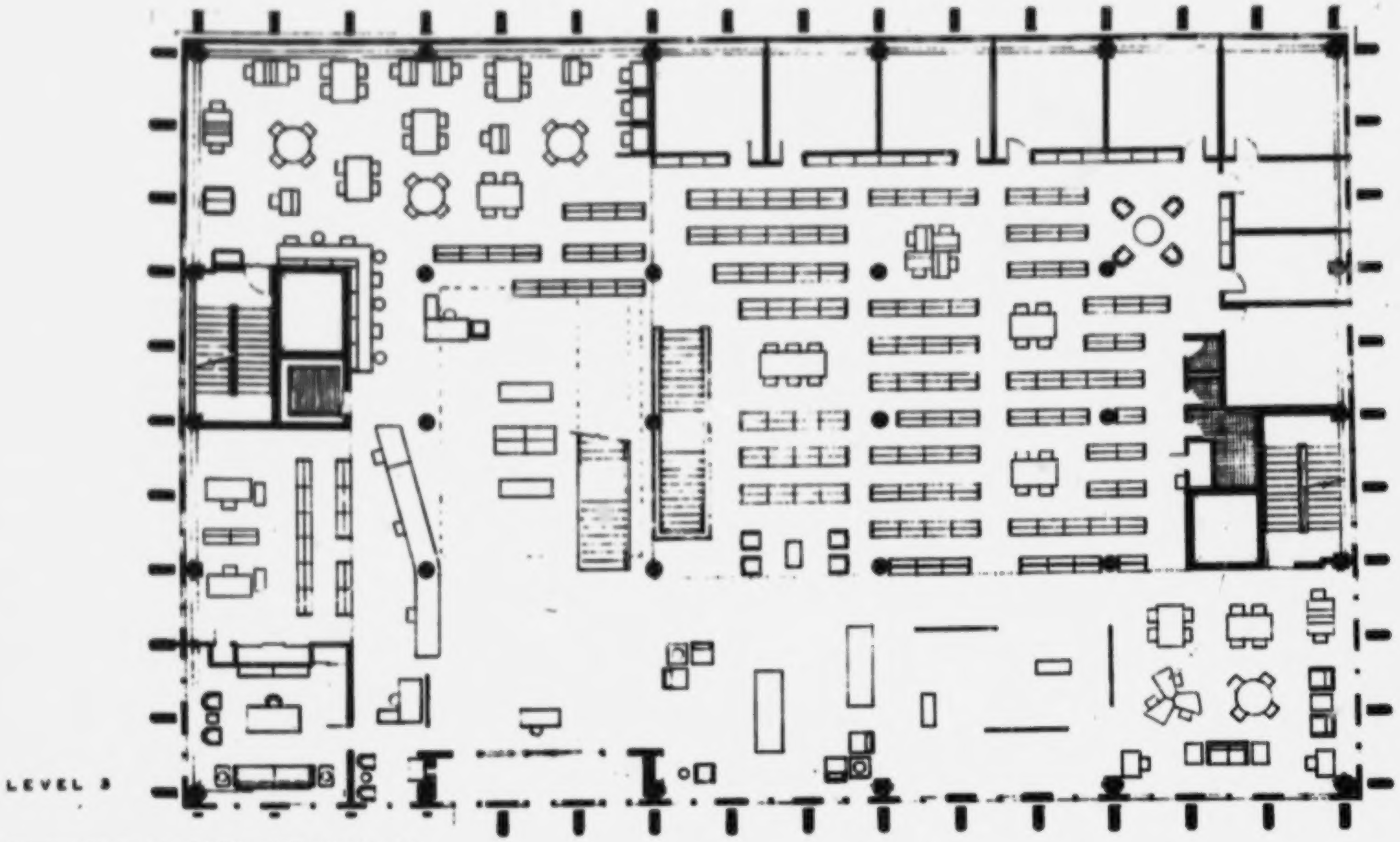
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 12



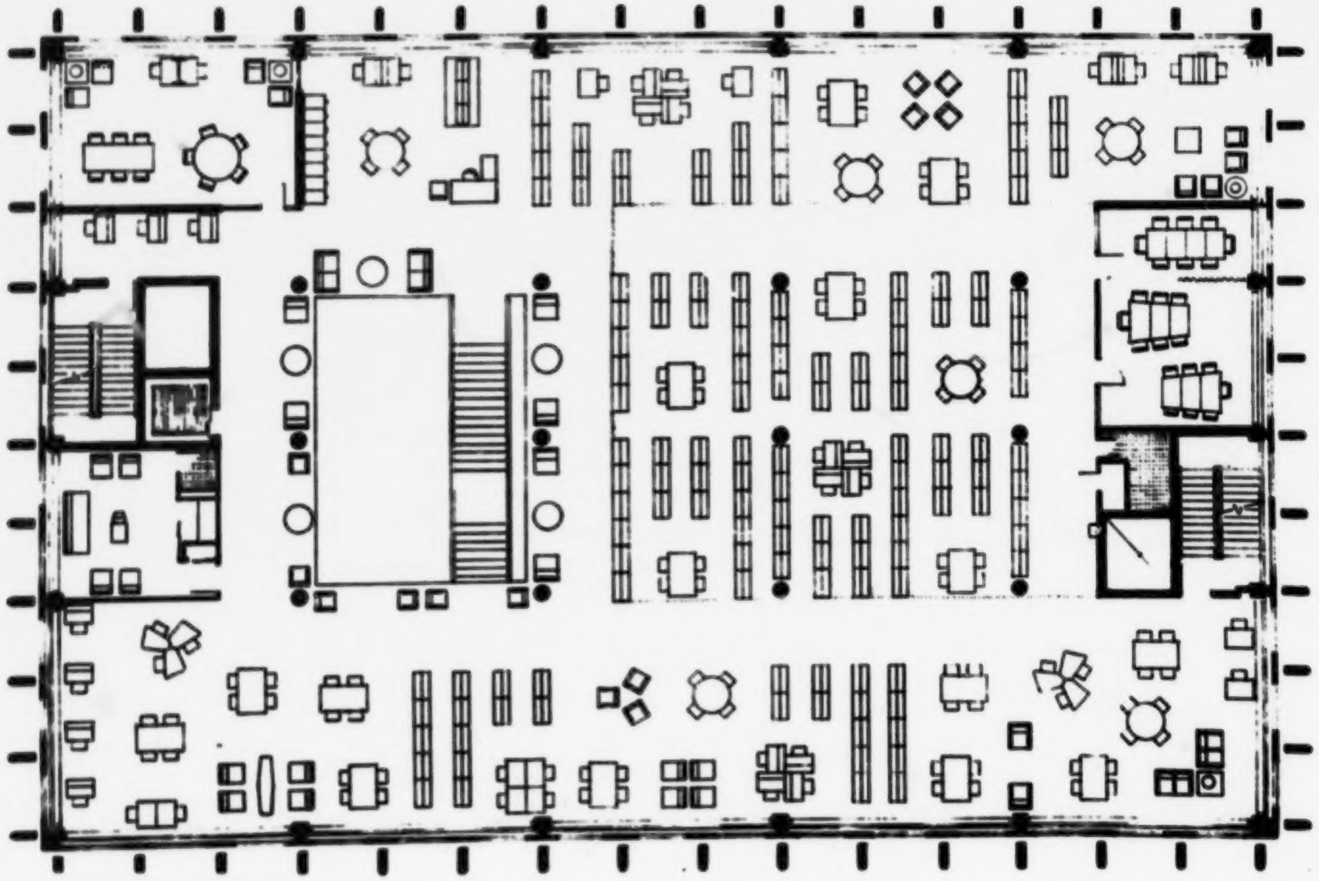
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 13



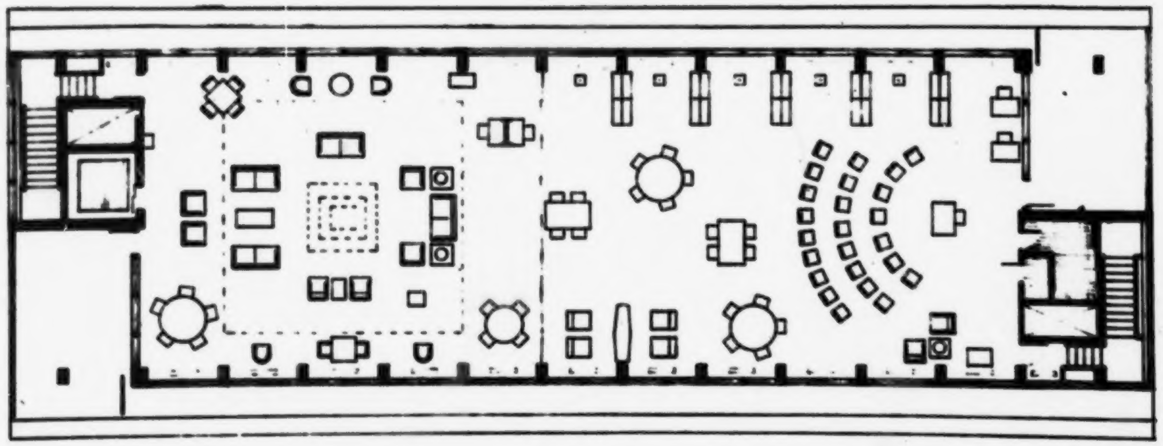
Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

Figure 14



Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

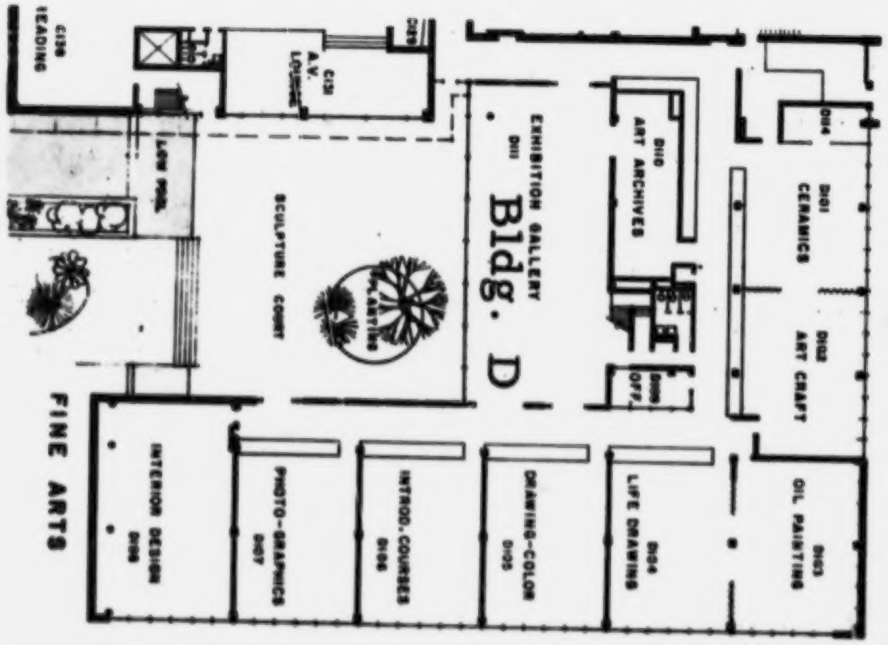
Figure 15



LEVEL 5

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

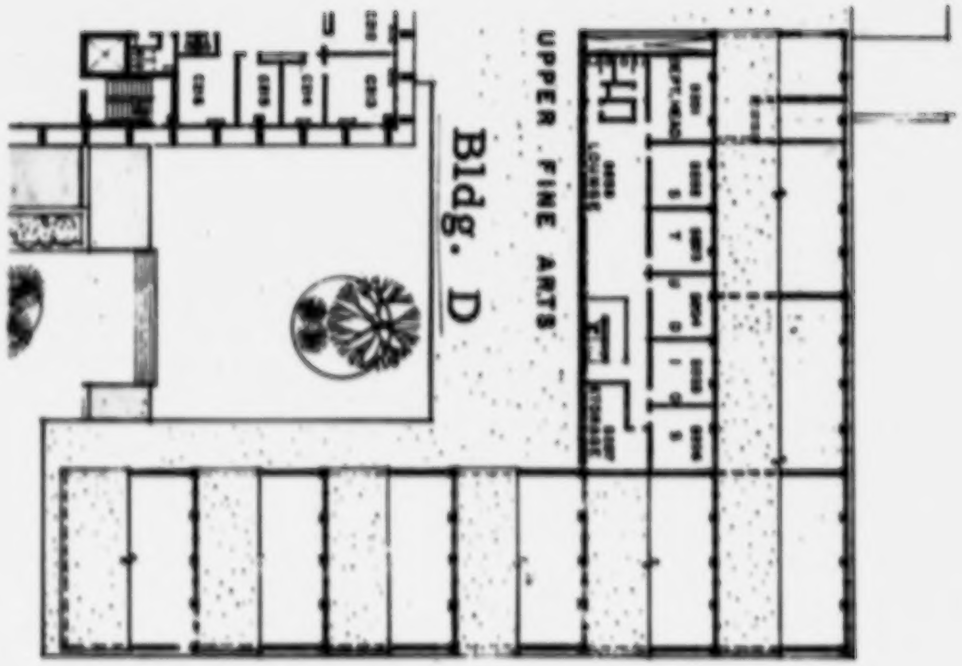
Figure 16


D114
D101 CERAMICS
D102 ART CRAFT
D103 OIL PAINTING
D110 ART ARCHIVES
D109 OFF.
D104 LIFE DRAWING
EXHIBITION GALLERY D111
Bldg. D
DRAWING-COLOR D105
INTROD. COURSES D106
PHOTO-GRAPHICS D107
INTERIOR DESIGN D108
C129
C131 A.V. LOUNGE
PLANTING
SCULPTURE COURT
LOW POOL
C130 READING
FINE ARTS

LEVEL 2

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

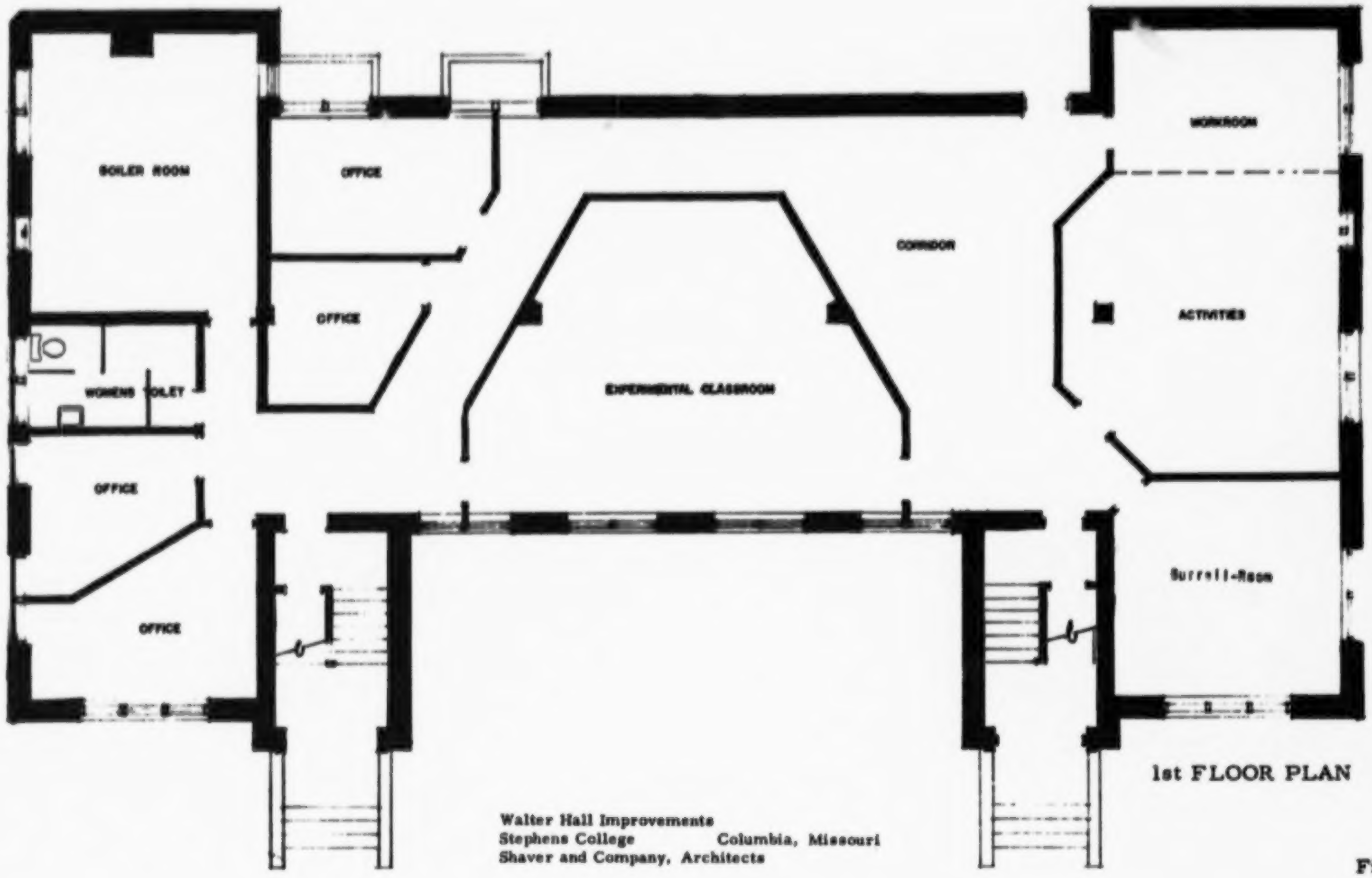
Figure 17


UPPER FINE ARTS
Bldg. D
DEPT. HEAD
S T U D I O S
LOUNGE
STORAGE

LEVEL 3

Learning Center, James Madison Wood Quadrangle
Stephens College Columbia, Missouri
Murphy & Mackey, Architects 1962

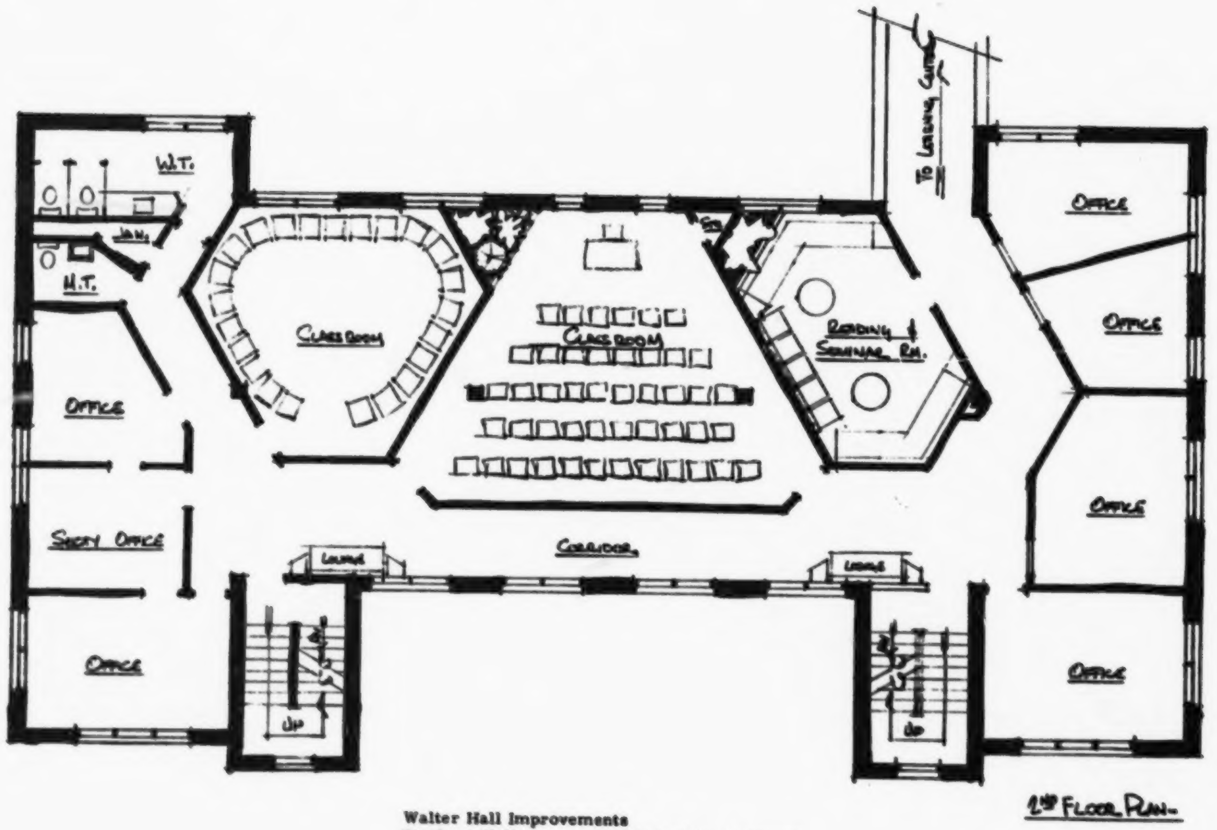
Figure 18


BOILER ROOM
OFFICE
OFFICE
WOMENS TOILET
OFFICE
OFFICE
EXPERIMENTAL CLASSROOM
CORRIDOR
WORKROOM
ACTIVITIES
Burrell-Room

1st FLOOR PLAN

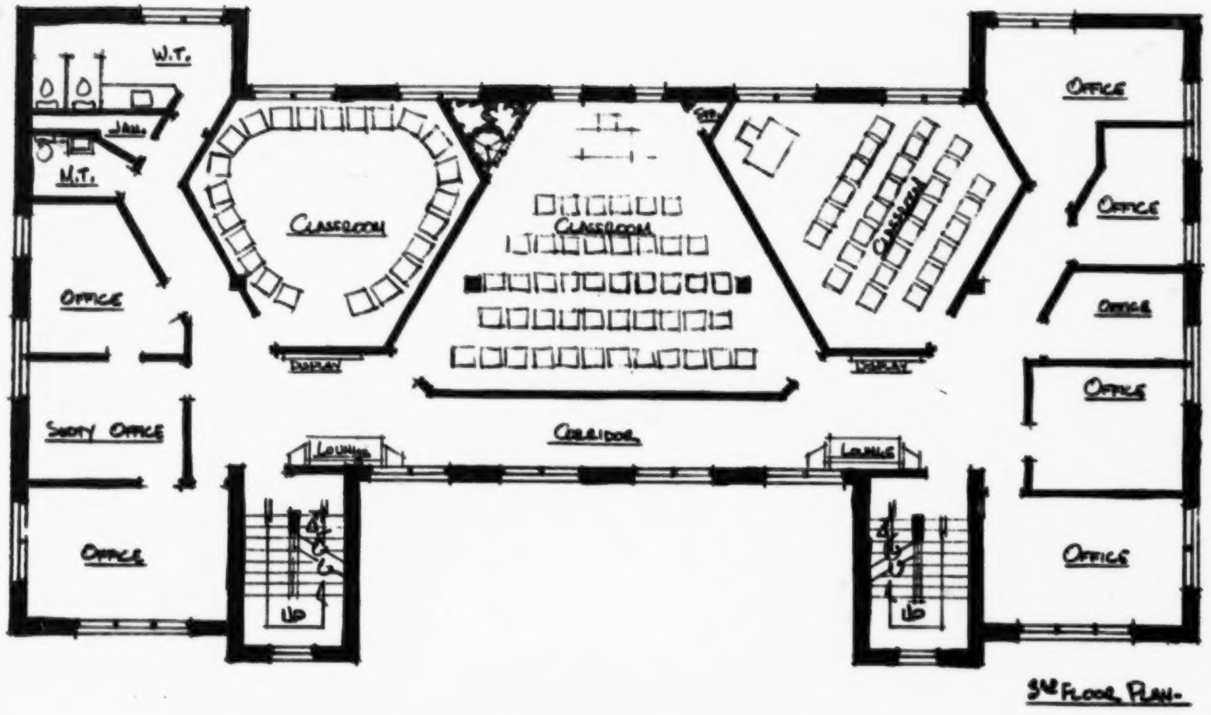
Walter Hall Improvements
Stephens College Columbia, Missouri
Shaver and Company, Architects

Figure 19


W.T.
JAN.
M.T.
CLASSROOM
CLASSROOM
READING & SEMINAR RM.
TO LEARNING CENTER
OFFICE
OFFICE
OFFICE
OFFICE
OFFICE
SECY OFFICE
OFFICE
CORRIDOR
LOUNGE
LOUNGE
UP
UP
2ND FLOOR PLAN-

Walter Hall Improvements
Stephens College Columbia, Missouri
Shaver and Company, Architects

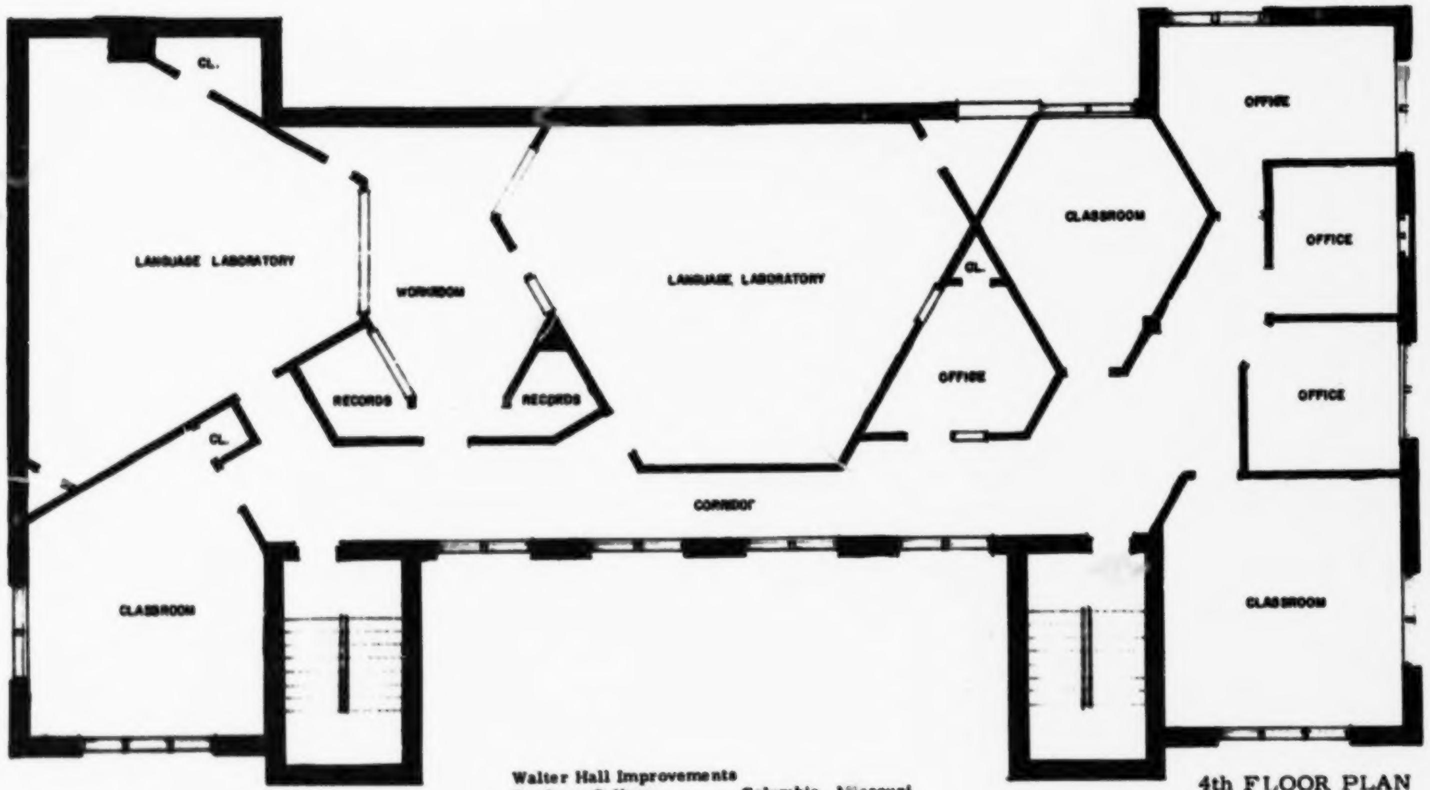
Figure 20



W.T.
JAN.
M.T.
OFFICE
SECTY OFFICE
OFFICE
CLASSROOM
CLASSROOM
CLASSROOM
DISPLAY
DISPLAY
CORRIDOR
LOUNGE
LOUNGE
UP
UP
OFFICE
OFFICE
OFFICE
OFFICE
OFFICE
3rd FLOOR PLAN-

Walter Hall Improvements
Stephens College Columbia, Missouri
Shaver and Company, Architects

Figure 21


CL.
LANGUAGE LABORATORY
WORKROOM
RECORDS
RECORDS
LANGUAGE LABORATORY
CL.
OFFICE
CLASSROOM
OFFICE
OFFICE
OFFICE
CL.
CLASSROOM
CORRIDOR
CLASSROOM

Walter Hall Improvements
Stephens College Columbia, Missouri
Shaver and Company, Architects

4th FLOOR PLAN

Figure 22

PART II

THE TECHNOLOGICAL STUDY OF NEEDS

Chapter 5

OBJECTIVES OF THE TECHNOLOGICAL STUDY

Objectives of the RCA Educational Advisory Services Report

This report constituting Part II of the present volume, has a twofold purpose: (1) It is intended to provide specific guidance for the faculty and administration of Stephens College, Columbia, Missouri in the selection and evaluation of equipment and electronic systems for a group of new buildings to be known as the James M. Wood Learning Center, currently under construction on the Stephens Campus. (2) It is intended to serve as a general guide for other colleges seeking information on the application of modern communications technology to the educational process.

To enable the reader to understand properly the context of the study reported here, it is desirable to quote directly from several sections of the pertinent contracts.

The formal objective of Contract No. OE 2-16-022 between the United States Government and Stephens College is "to investigate and verify precise technological information necessary to the selection and effective use of a variety of electronic and mechanical aids to learning--aids that are compatible with each other and with an integrated cross-media utilization of them in a 'learning center' to be built on the campus of Stephens College, and to prepare a manuscript useful to the colleges of the Nation, describing the plans, the use to which the facilities will be put and the goals that are sought."

RCA's responsibilities under its subcontract with Stephens College are defined by the following statements of "Work to be Performed" from its proposal to Stephens College, incorporated by reference into the subcontract itself:

"RCA proposes to approach the development of electronic systems for the Learning Center exactly as it would approach a major systems engineering problem in communications. Paramount in our study will be the key concepts of flexibility, proximity, availability and variety for the student, the teacher, and the resources and devices that aid learning. All final recommendations will be in terms of increasing educational effectiveness within a price range of an institution of the size and resources of Stephens College.

"RCA proposes to:

1. Perform a professional engineering analysis of the requirements for audio-visual aids, communication systems, data-processing systems, and other electronic systems that may be required or desirable for the effective operation of Stephens College in accordance with the educational objectives established by the faculty.
2. Survey the existing facilities and perform a professional engineering analysis of their effectiveness for meeting Stephens College's current and future objectives, particularly in combination with the proposed new facilities to be installed in the James M. Wood Learning Center.
3. Prepare recommendations for alternate and additional systems, facilities, and equipment that should be installed both in the James M.

Wood Learning Center and elsewhere on the campus to assure maximum effectiveness in carrying out the educational objectives of Stephens College. These recommendations will be supported by studies of architectural requirements, personnel requirements for both operation and maintenance, and economic factors.

4. Prepare detailed, non-proprietary guide specifications for the systems, facilities, or equipment agreed upon by the study team and the Stephens College administration and faculty, as necessary or desirable for the future development of the College. Such specifications shall be in terms of performance requirements, not superficial design details.
5. Provide technical guidance for the testing and evaluation on the Stephens campus of such prototype devices as may be obtained for consideration as future facilities.
6. Prepare a composite report incorporating the results of the above investigations, studies, and recommendations. This report should be suitable both for immediate use by Stephens College personnel in making decisions concerning facilities of its Learning Center and for future use by other colleges."

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Chapter 6

A BRIEF ENGINEERING ANALYSIS OF EDUCATION

The Systems Engineering Approach to Educational Facilities

Because education is essentially a communications process, it is reasonable to assume that many of the technological developments of the communications engineer should be of major benefit to education. The two senses most directly involved in education are vision and hearing, and a wide variety of optical and electronic devices have been developed to extend human capability in these two senses. Electronic devices have also been developed which duplicate, at least in a rudimentary sense, many of the functions of the human brain, notably memory, recall, and the application of logic. While such devices in no sense replace the brains of either teachers or students, they can be used to extend the capabilities of both.

Electronic and mechanical aids to education have been available since the earliest days of the motion-picture projector and phonograph, but few of them have been developed to the point where their potential has been fully realized. The RCA study team believes that a primary reason for the relatively slight impact of many audio-visual aids has been the lack of an overall systems concept. Educators are now confronted with an almost bewildering array of instruments, most of which are useful for only a few specialized tasks. Many of the devices currently offered as "aids to education" are actually rather poor adaptations (from the point of view of an "educational engineer") of devices designed primarily for use in some other field, such as home entertainment, the theatre, or business. Educators have, in general, failed to apply even the best-adapted aids on a sufficiently intensive scale to realize their full benefit.

Through such activities as the Stephens College Learning Center project, a few pioneering educators are now learning that close professional association with educationally-oriented systems engineers can stimulate major progress in the application of technology to education. Attention can now be focused on large-scale systems with a level of use great enough to justify their cost, rather than on a series of isolated "gadgets" used only occasionally for specific tasks. There is now awareness, at least by a few educators, that even devices intended for use by individual instructors or individual students must be used systematically, and backed up by realistic, economically-justifiable systems for producing and distributing the materials utilized or consumed by the devices.

The educationally-oriented systems engineer does not simply evaluate the new devices or concepts emerging from technological developments in other fields and ask: "How may this device or concept be used in the cause of education?" (Unfortunately, much of what passes as "new media research" in education is oriented in this very direction.) Instead, the systems engineer applies a thorough knowledge of what is both available and possible in technology to his studies of an educational institution's needs. When sound professional judgment indicates that new developments are required to solve certain of the communications problems in education, a clear statement of the technical requirements, prepared by a professional engineer, can serve as a first step in stimulating the new developments. It is significant that a good communications engineer has training in economics and psychology as well as in purely technical areas; he appreciates that his recommendations must reflect economic feasibility and acceptability to the user no less than technical feasibility.

It must be emphasized that realization of the full potential of technology in education will require increasingly close cooperation between engineers and educators. While some technological devices or systems serve primarily to reinforce the traditional roles of teachers and students, others may profoundly influence the very character of an educational institution, just as the industrial revolution has profoundly influenced the character of the manufacturing industry. Indifference to educational technology may be short-sighted and wasteful, but blind acceptance of technology may involve social upheaval with disastrous consequences for teachers and students alike. The need, of course, is for a "balanced" approach, seeking progress through evolution, not revolution.

Technological Implications in the Stated Objectives of Stephens College

College architectural designs and technological systems should never be regarded as ends in themselves, but only as means toward the attainment of educational objectives. To establish a realistic context for discussion of the technological systems recommended for the James M. Wood Learning Center, let us identify some of the communications problems implied by the stated objectives of Stephens College.

As noted in Chapter 2, and clearly stated in its catalog, the primary objectives of Stephens College are: (1) the stimulation and guidance of learning, and (2) the growth and development of each student as an individual and as a responsible member of society. From the point of view of the communications engineer, attainment of these objectives involves at least six identifiable requirements, in each of which technological aids might be employed to advantage.

1. A Concentration of Learning Resources. While learning can take place in any environment, institutions of higher education exist primarily to provide a concentration of learning resources to make learning easier and more effective. While professors or other faculty members constitute some of the most important learning resources of a college, many other resources reside in books or other forms of recorded information, and in such physical facilities as laboratories and practice rooms. Intelligent use of technological devices, systems, and materials makes possible the concentration of an extremely wide variety of learning resources.

2. Reasonable Access to these Learning Resources. Virtually all of the resources provided by Stephens College (or any other college, for that matter) are stored in some form, and most of the activities in which a student engages during her period of enrollment are intended to give her access to these stored resources. Lectures, class sessions, seminars, and private conferences are essentially means to give students access to the learning resources stored in the living cells of human brains. Technological aids which help a professor to do a better job of presenting material (that is, improve his effectiveness in communication) are, in a very real sense, means for improving the access by students to an important learning resource. Some of the learning resources in recorded form, notably books, are even more accessible to students than the "live" resources, and more systematic use of technology in education could greatly improve the accessibility of all forms of recorded knowledge and skill.

3. Opportunities for Significant Variations in the Use of Learning Resources. Stephens College can realistically guide the growth and development of each student as an individual only to the degree that opportunities exist to adapt the available learning resources to fit individual needs. The potential role of technology in satisfying this requirement is reviewed in a later section of this report.

4. Opportunities for Students to Engage in Educationally Significant Activities to Reinforce Learning. While there are many theories of learning, most of them recognize that learning occurs only when the student makes some type of active response (mental or physical) to a visual or aural stimulus. The potential of technological aids in this field has barely been tapped, except in such specialized areas as science laboratories and language laboratories. Many traditional types of student activity, such as note-taking, recitation, book reports, term papers, and class discussion require only nominal use of technological aids, and clearly deserve continued use in appropriate learning situations. A relatively recent technique for assuring student activity, but one that has already attracted a great deal of attention, is programed instruction, which requires some active response by the student for virtually every item of information presented. Through the use of relatively simple technological devices, it should be possible to realize some of the advantages of programed instruction, notably the sustained activity on the part of the student, in a wide variety of teaching-learning situations. With an appropriate response recording and indicating system, for example, it would be possible to permit every student to respond actively and continuously during the presentation of either "live" or televised lectures, to the benefit of student and lecturer alike.

5. *Means of Placing Students in Growth-Stimulating Social Situations, and in Meaningful Contact With the World Outside the Campus*. The interest of Stephens College in guiding the growth and development of each student as a responsible member of society implies that treatment of students as individuals must not be carried so far as to treat them as isolated individuals. Under the guidance of properly-trained faculty members, social development is possible in almost any of the group activities normally associated with education, including recreational activities and the informal activities of dormitory life. The technological aids that influence social development are primarily architectural in nature. That is, means must be provided for groups of various sizes to gather in surroundings that are appropriate for the learning and social-development objectives. For significant interaction between students, it is important that they be able to *see* and *hear* each other properly. Seating arrangements, lighting, and acoustic design should not be left to chance either in classrooms or in lounges and other informal gathering-places.

Technology can be used to great advantage in bringing students into meaningful contact with the larger world beyond the Stephens campus. The amplified telephone interview, already in use at Stephens, makes virtually any of the nation's intellectual or political leaders available as a learning resource. Guided use can also be made of the broadcast media, including international short-wave radio, to bring in resource materials that will keep Stephens students aware of the major developments in the world as a whole. Intelligent use of recording techniques can overcome many of the schedule handicaps that normally prevent full utilization of broadcast resources.

6. Means for Evaluating the Needs and Progress of Individual Students. Implicit in the Stephens College goal of individual development of each student is the requirement that means be available to measure the progress of each student and to establish just what her needs and personal learning objectives are. The test and evaluation methods commonly used in education are relatively crude (from an engineering point of view) and highly subjective. To date, very little use has been made of technology for the testing and evaluation of student performance, except for the machine scoring of so-called "objective" examination papers. Major improvements in testing and evaluation techniques could be made through the systematic use of relatively simple technological concepts, notably data-processing techniques. Suppose, for example, that a response recording system were able to maintain a complete, permanent record of the responses made by each student during nearly every lecture session, during her independent viewing of recorded instructional materials, during her study of programed materials, and during formal examination periods. Such a mass of data would be more than faculty members could evaluate by manual techniques, but data-processing machines could be used to analyze the data to show significant strengths, weaknesses, and trends in the student's performance. If designed appropriately, the same response recording system could also build a permanent record of the actual learning resources used by the student--what books she has read, and in what sequence, what programed instruction materials she has used, what tapes or films she has reviewed, what classes she has attended. Used wisely, processed information of this type could be of great value to faculty counselors in their efforts to guide and stimulate learning.

> In the field of testing, it seems appropriate to employ examination techniques that are generally comparable to presentation techniques. The RCA study team feels that the Learning Center facilities should give Stephens College an opportunity to conduct significant research in the use of such technological aids as slides, films, and television to conduct examinations. It is almost incongruous to provide highly-advanced audio-visual learning resources and to continue to rely on traditional verbal examinations to measure the effectiveness of these resources.

Technology and Individual Learning Opportunities

"First and foremost, Stephens considers students as individuals with differing abilities...."

To even the casual visitor at the Stephens campus, there can be no question about the sincerity of this clearly-stated principle of the Stephens faculty and administration. Yet, the ability of any college to serve the individual needs of students is ultimately limited by its physical and financial resources. In any educational institution, there are innumerable instances of situations where it is necessary to handle students collectively, rather than as individuals. The very custom of grouping students into classes, and of placing large numbers of them on identical or very similar schedules is, of course, a violation of the principle of truly individual instruction. Such collective handling of students is usually made necessary by economic factors, but it should by no means be condemned as totally undesirable. Fortunately, many students have needs in common which can be met by common experiences. There are also positive values derived from the social interaction which is possible only when large numbers of students share common learning experiences. Even if a college could afford to hire outstanding teachers on a one-per-student basis, there would still be great virtue in bringing students together in sizable groups for specific purposes.

A college which gives more than lip service to the principle of individual attention to student needs must equip itself with the resources necessary to make such individual attention possible and financially attainable. A significant increase in the truly individual learning opportunities available to Stephens' students is, of course, one of the major benefits expected from the operation of the James M. Wood Learning Center. As further background for discussions of the facilities recommended for this Center, therefore, it should be helpful to review briefly the major factors which may be varied to adapt a college program to the needs of individual students, and to identify the potential role of technology in each instance.

1. Variable Curriculum. Nearly all colleges offer more courses than any single student could expect to take during the normal period of enrollment, and students are given a certain degree of freedom (under the guidance of faculty counselors) to select those courses which best meet their own needs. Through technology, it is possible to base many courses on television, film, or audio recordings, making possible a much wider range of courses with given faculty resources. To the degree that faculty resources are limited more by time than by talent, such recorded courses can be produced locally. (A professor who has recorded a complete course can realistically teach two courses at the same time). As the use of recorded instruction grows throughout the country, Stephens will have opportunities to extend its curriculum at relatively modest cost through recorded courses prepared by outstanding teachers at other institutions. Through recordings, it is also

possible to schedule class sessions for a given course more frequently, making courses more accessible to students who might normally be prevented from taking them because of schedule conflicts.

2. Variable Content. When a professor has the opportunity to evaluate the needs of individual students, he may be able to adjust over wide limits the total content of a given course for students of differing needs, interest, or ability. Where class groups are involved, a minimum level of learning opportunities may be provided by group experiences, while supplemental opportunities are provided by individual reading assignments, listening or viewing assignments, programed instruction materials, private conferences, or guided projects.

3. Variable Time. A realistic approach to the recognition of individual differences is adjustment of the total time spent by the student to master a body of knowledge or to develop a particular skill. Unfortunately, adherence to rigid lecture or class schedules severely limits freedom in this respect. To the degree that reliance is placed on recorded forms of instruction (including programed instruction and conventional books), it should be possible to make much greater use of this variable than is customary at the present time. A student who is capable of mastering a subject in, say, 10 weeks instead of the "normal" 16 should be permitted to do so, leaving her free to go on to another subject or to engage in a worthwhile project.

4. Variable Sequence. The sequence in which information is presented often influences learning, and a given sequence may not be optimum for all students. An experienced professor normally adapts the sequence of his material

to fit the needs of the majority of students in each class, but he is limited in serving the needs of every student. Recorded instructional materials, if prepared with variable sequence as an objective, can provide greater flexibility than normal classroom procedures in meeting the needs of individual students. Obviously a complete course that is recorded as a series of programs that must be used in a fixed sequence to preserve the logical structure is even more rigid than classroom instruction, but it is technically possible to record the total content of a course in a number of reasonably independent units, possibly using a variety of media. Conventional books and programed instruction materials can also be designed for use in variable sequences.

5. Variable Format or Method. A given body of knowledge or skill can be communicated in a wide variety of ways, utilizing a wide variety of media, each of which may offer advantages for certain students. In some cases, it is possible to give students a limited choice of presentation method by assigning more than one professor to teach a given course (there are bound to be individual differences between professors). A much greater variety in presentation method or format can be provided through technology, utilizing the various approaches to recorded instruction.

Technology and the Effectiveness of Professors

A professor is added to the faculty of a college only because he presumably possesses some knowledge or skill worth passing on to students. College administrators are understandably interested in obtaining maximum benefit from the services of each professor, consistent with the educational objectives of the institution. As a professional person, the professor himself should be strongly interested in making the maximum contribution to his institution and to his students permitted by the resources available to him. Thus, both administration and faculty have reason to be interested in the degree to which teaching effectiveness and efficiency can be improved by the use of technological aids.

It should be noted that many of today's conventional educational techniques and customs have been developed primarily to improve efficiency. The large lecture section, for example, can scarcely be defended as a way to meet the individual needs of students, but it is a relatively economical way of using the services of a competent professor. (It is better for a student to come under the influence of a gifted professor as a member of a large audience than to receive only mediocre instruction or no instruction at all in a given field.) Likewise, the relatively arbitrary grouping of students into classes by age and alphabetical sequence, and the firm scheduling of the school day and the academic year, are justified more by economic considerations than by good educational practice.

To a serious student, a professor is primarily a learning resource, offering both advantages and disadvantages relative to other learning resources, such as books and recordings of various types. The "live" professor has the great potential advantage of direct, personal interaction and two-way communication, but this advantage is significant only to the degree that the professor is truly accessible to the student. To be realistic, one must recognize that true two-way communication exists only at the convenience of the professor, and is severely limited by time and physical facilities. In most college classes, only a relatively small number of students have the opportunity (and, sometimes, the inclination) to become really well acquainted with the professor; to the rest of the students, he may be not only a relatively inaccessible learning resource, but one whose schedule demands may conflict seriously with other learning opportunities. If a professor has developed the bad habit of delivering uninspired lectures, totally devoid of content or illustrations not also contained in textbooks, it should not be surprising that serious students show less respect for that professor than for other learning resources.

A professor who is truly enthusiastic about his subject, and who has a genuinely professional interest in teaching, should be continually seeking opportunities to improve his communications skill and to make his talents more readily accessible to students. The professor should properly regard technological aids both as learning resources for his students and as professional tools for his own use. An audio-visual presentation technique that communicates the professor's thoughts more clearly than audio comments alone is generally worth using, even though it requires more preparation effort, because of the superior learning opportunity it provides for students. If a presentation requires more preparation time or effort than can be justified for a single use, the professor should give serious consideration to recording the presentation in a suitable medium, making it available not only for his own repeated use, but also for independent use by students as an additional learning resource.

In addition to his direct teaching role, a professor is normally expected to be interested in the development of new knowledge (through research) and in making contributions to the world's "storehouse" of recorded knowledge. In the past, the primary means by which a professor could communicate his knowledge beyond the classroom or lecture hall was by writing a book (which is, of course, a technological device). If a book is of exceptional quality, it may live for centuries, making the knowledge and insight of its author available to many more students than he could ever hope to meet in his lifetime. If the book is of only average quality, its effective lifetime may be only a few years, but it still serves to widen the scope of the author's influence. With the aid of newer technological devices, professors now have the opportunity to record their "messages" in a great variety of forms to make them even more helpful to students. Provided an institution has appropriate facilities for distributing and using recorded materials, a professor who records his knowledge in any form becomes much more accessible to students, since his physical presence is no longer required in all instances.

Ideally, a professor should be something of a "counselor" to each of his students. He should have the opportunity to become sufficiently well acquainted with each student to understand his educational needs as they relate to the professor's field of instruction, and he should be able to "prescribe" a highly individual program of instruction and study to meet the student's needs. As noted earlier in this report, technological devices or systems can be used to assist the professor in measuring and evaluating the performance of each student. To do a proper job of stimulating and guiding the learning of individual students, a professor must become intimately acquainted with the full range of learning resources in his area of specialty, and must assume a large measure of responsibility for developing and keeping up-to-date that section of his institution's Resources Library devoted to his subject field.

Chapter 7

A PRELIMINARY REVIEW OF POSSIBLE TECHNOLOGICAL SYSTEMS FOR THE LEARNING CENTER

Objectives of this Preliminary Review

The preceding section of this report represents an attempt to identify the major communications problems involved in accomplishing the educational objectives of Stephens College. The reader's attention is now directed to brief verbal pictures of technological systems that might be used in the James M. Wood Learning Center to solve these problems or to accomplish the educational objectives. Many of the systems proposed are of sufficient complexity that separate chapters in this report are required for appropriate discussion of their educational, technical, and economic implications. This preliminary review is intended to help the reader place the several systems in context and to appreciate their relative significance.

The systems discussed here reflect the minimum requirements established by the Stephens faculty prior to the RCA study, but have been extended significantly in several areas as a result of the analysis summarized in Chapter 6. "Hardware" to support some of the systems suggested here does not exist at the present time, but all of the systems are judged to be technically feasible by the engineering members of the RCA study team. In the more detailed discussions in later chapters of this report, the present technological status of each major system or technique is reviewed and specific suggestions are made for the orderly development of Learning Center facilities.

Identification of Major Systems

While virtually all of the technological systems that might be installed in the Learning Center are interrelated to some degree, they may, for discussion purposes, be separated into eight major categories, as shown below:

1. Audio-Visual Teaching Aids. The classrooms and other instructional spaces in the Learning Center should certainly be equipped with facilities to permit the use of a reasonable variety of audio-visual teaching techniques. From an engineering point of view, there are only three truly basic technological requirements to support audio-visual teaching: (a) the display of still pictures, (b) the display of moving pictures, and (c) the reproduction of recorded audio materials. (One could even argue that there is no really basic difference between the projection of still pictures and motion pictures, since "movies" are actually nothing more than a rapid sequence of still pictures, but the technical requirements for "hardware" are sufficiently different in these two cases that the techniques are considered separately in this study.) There are many alternate approaches to each basic technique, and they are frequently used in combinations, as when a sound track is recorded along the edge of motion picture film, or still pictures are changed automatically by tone signals incorporated in an audio recording. Although standardization should play an important role in the planning of Learning Center facilities for systematic use of audio-visual teaching aids, it will probably be necessary to provide more than one means for accomplishing each of the basic technological requirements. For example, the overhead projector and the slide projector represent alternative means for projecting

still pictures, but each device offers such distinct advantages that it is not economically wasteful to provide both devices in the same room. It will probably never become necessary to equip all classrooms in the Learning Center with permanent facilities for all known audio-visual teaching techniques, but equipment should be available in sufficiently generous supply to support the most effective possible use of audio-visual techniques.

2. Facilities for the Production of Materials. The best educational facilities in the world are useless without a good supply of materials to be used with them. While many materials can be purchased from outside sources through commercial or non-profit channels, a great many items required to support the educational objectives of Stephens College can only be obtained by local effort. Thus, it is important that plans for the James M. Wood Learning Center include provision for producing reasonable quantities of materials in each of the media used to reinforce teaching and learning activities.

3. Production and Recording Facilities for Television, Film, and Audio Programs. A significant amount of space in the James M. Wood Learning Center is allocated to radio, television, and film studios and the related technical equipment. Although Stephens is a relatively small college, a substantial investment in facilities for producing and recording television, film, and audio programs is justified by two factors: (a) the facilities are needed as "laboratory" areas to support the College's programs in the Radio-TV-Film Department, and (b) the facilities permit the relatively economical production of recorded materials needed as both teaching and learning resources.

4. Audio and Video Distribution System. Plans for the Learning Center include an extensive network of coaxial cables and audio lines to permit distribution of both television and audio programs by closed-circuit techniques. (An FM broadcast transmitter may eventually be added to the Learning Center facilities as an extension of the basic distribution network, capable of rendering significant educational service to the entire community.) Such electronic distribution provides an economical and practical way to make many of the learning resources in the Center readily available to students. Signals will be distributed not only to classrooms and lecture halls, but also to lounges and individual study spaces in the Resources Library. The system should ultimately be extended to all dormitory rooms.

5. Learning Laboratories. At least two specific rooms in the Learning Center are to be equipped with so-called "language laboratory" facilities, permitting students to utilize audio materials on an individual basis, and providing opportunities for individual oral responsesunder the guidance of language professors or instructors. The study team suggests that the usefulness of these laboratories be extended into other areas of instruction and learning by incorporating additional facilities for individual audio-*visual* stimulation and opportunities for responses in a greater variety of forms. While "optimum" equipment for such "learning laboratories" has not yet been developed, it is technically possible to utilize technological aids to support a wide range of programed instruction materials.

6. Response Recording System. To permit the systematic measurement and evaluation of the educational development of each student, the

study team recommends that a unified response recording system be developed for installation throughout the Learning Center. Such a system could be used for the recording of student responses in connection with conventional classroom instruction, televised instruction, and individual or group programed instruction. The same facilities could also be used for the administration of formal examinations, and would permit automatic scoring by data processing equipment. As a secondary benefit, the system could be designed to permit monitoring of the teaching process as well as the learning process, permitting instructors to evaluate their own effectiveness even during an active class period.

7. The Resources Library. Since one of the major objectives of the Learning Center is to make a wide variety of learning resources freely available to students, it is important that the Resources Library within the Center be well equipped with the technological devices required to permit convenient use of recorded information in all forms. The traditional library has evolved as a facility for both storing and utilizing books and other printed media. Most so-called "audio-visual libraries," on the other hand, are essentially nothing more than warehouses or shipping centers, lacking in facilities which permit ready access to the materials by large numbers of people for on-the-spot "browsing" or serious study. Standardization on a relatively small number of basic media is an important step in developing a true audio-visual "library," and several new types of equipment are needed to provide practical access to materials by individual students. In later sections of this report, the study team presents specific suggestions for the gradual development of the Resources Library at

Stephens College by utilizing the most suitable technological devices now available and encouraging the development of improved devices.

8. Other Systems and Facilities. The major systems mentioned above by no means exhaust the possibilities for applying technological aids in the Learning Center. Several additional systems are identified and described very briefly in the following list.

   (a) Intercommunication facilities are planned to link many of the classrooms and faculty offices throughout the Learning Center.
   (b) Amplified telephone facilities will be installed in several classrooms to permit group interviews with prominent people who may be unable to visit the Stephens campus.
   (c) Sound reinforcement equipment is to be installed in the Assembly Hall, Cinema Laboratory, and Multi-Purpose Rooms, along with audio-visual teaching aids.
   (d) Data-processing facilities for both administrative and academic purposes may eventually be installed within the Learning Center, especially to support the use of the response recording system.
   (e) Observational television cameras may find a number of applications throughout the Learning Center as demonstration aids and tools for remote observations. The video transmission system should permit recordings to be made from the output of such observational cameras located almost anywhere on the Stephens campus.
   (f) Display facilities may include audio devices to provide recorded commentaries to describe art exhibits or other displays. Automatic audio-visual devices

might also be used to provide "animated" exhibits in lobbies, lounges, and other display areas.

Major Problems Involved in the Realization of Practical Learning Center Facilities

Common sense indicates that it would be unwise for Stephens College to attempt to complete the installation of all possible technological facilities in the Learning Center prior to its formal opening for use by faculty and students. The following very practical problems should be taken into account in planning the "timetable" for development of the Learning Center.

1. The "Technological Gap." Even if Stephens College wished to equip the Learning Center immediately with the full range of facilities described in this preliminary review, they would find it impossible to do so, simply because satisfactory equipment designs are not yet available in all categories. There is, in effect, a "technological gap" between what is available today and what is really required to meet the needs of Education. As noted in Chapter 6, many of today's electronic "aids to education" are really adaptations of devices designed for rather different applications. Only recently has serious systems engineering attention been given to the problem of developing optimum educational facilities, and the fruits of this systematic study have not yet been widely felt. In general, the technological concepts needed to solve almost any of the communications problems in education are now available and well understood, but many specific devices and systems remain to be developed. The speed with which such developments are completed depends upon many factors, not the least of which is the problem of financing both the development programs and

the subsequent purchases of equipment by educational institutions.

2. Costs. Although the total investment in Learning Center facilities is never likely to become more than a relatively small fraction of the investment in the architectural plant, it must be recognized that many of the proposed facilities represent very sizable expenditures for tools of relatively unproved educational effectiveness. From a financial point of view, it is probably desirable to spread major investments over a period of several years to minimize stress on the College's financial resources. Where significantly new concepts are involved, it is both good business practice and good educational practice to insist upon "pilot" installations of relatively modest scale before a complete commitment is made to untested facilities. It should be noted, however, that experimental, small-scale use of a new medium or technique may require a financial subsidy, since the costs of many technological aids to education become justifiable only when used intensively on a relatively large scale. Thus "pilot" projects should generally be continued only long enough to prove or disprove the educational theories being tested. The RCA study team has made a sincere effort to reflect an understanding of the financial limitations of the relatively small college in the specific recommendations presented in the later chapters of this report, although college administrators must learn to expect significant investments in tools as well as in buildings if they wish to reap benefits from educational technology.

3. Availability of Materials. It takes appreciable time to acquire a significant volume of useful materials in an audio-visual "library," and there is little point in owning audio-

visual devices in numbers that are out of proportion to the supply of materials to be used with them.

4. Faculty Training. In spite of the excellent acceptance of audio-visual teaching tools at Stephens College, there are still wide differences in the degree to which individual professors employ technological aids. Since significant changes in their work habits are involved, it will take time for professors to learn to take full advantage of the new resources that will be available to them and their students in the Learning Center. Introduction of new concepts or techniques in excessively large "doses" may lead to confusion, resentment, and subsequent resistance or indifference to potentially useful techniques. While it is probably wise to offer faculty members and students new resources in advance of the time they actually demand them, the planned growth pattern for Learning Center facilities should reflect an understanding of the human problems involved in the development of new roles for college professors and new activities for students.

Suggested Guidelines for Selecting Initial Facilities

Since it is not too practical to install all Learning Center facilities at one time, it is necessary to adopt some type of priority schedule and to establish reasonable criteria for selecting the items to be installed before the Learning Center is opened. While final decisions in this area must be made by the Stephens College administration (and are certain to be heavily influenced by the available funds), the RCA study team has based its recommendations on the following factors.

1. Major priority should be given to facilities related to the production of materials, since much of the effectiveness of the Learning Center in the near future will depend upon the rapid accumulation of a good supply of learning resources. Particular emphasis should be placed on materials or techniques which faculty members can learn to produce or utilize with minimum changes in established work patterns. As part of the total effort to stimulate maximum use of the Learning Center, it would be better to provide facilities for materials production that are somewhat in excess of current demands, rather than to insist upon full economic justification for a materials production facility before it is acquired.

2. Complete installations should be made prior to opening the Learning Center of those devices or systems that are of proved educational value and are based on firmly-established technological concepts not likely to change significantly in the next decade or so.

3. Devices or facilities requiring the use of relatively new materials that are in scarce supply should be installed gradually on a time schedule synchronized reasonably well with the anticipated increase in the materials supply.

4. Devices or systems involving relatively unproved educational concepts should be installed on a "pilot" basis only, with arrangements for careful evaluation of performance during a trial period.

5. In situations where the educational objectives of proposed facilities are clear, but the existing technology is considered inadequate or subject to near-future change, relatively

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temporary installations of the best available equipment should be made. To minimize economic waste, the scope of such systems (or the number of devices involved) should not be allowed to exceed current needs, and a re-appraisal of the status of the relevant technology should be made each time an expansion in facilities is required. With careful planning, it may be possible to introduce new technological developments by a process of gradual upgrading, rather than complete replacement.

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Chapter 8

AUDIO-VISUAL TEACHING AIDS - ANALYSIS AND RECOMMENDATIONS

Identification of Basic Problems in the Utilization of Audio-Visual Teaching Techniques

For purposes of this study, it is taken for granted that the regular use of audio-visual aids in college teaching should be encouraged. It is also assumed that the current level of utilization of audio-visual techniques is far below the optimum level, even at Stephens College where the majority of faculty members clearly favor the use of such techniques. The Learning Center project may be expected to provide fresh opportunities to overcome some of the problems which commonly limit the degree to which audio-visual aids are utilized. As a first step in reviewing the role that technology might play in this area, it is necessary to define the problems themselves.

From the current literature on audio-visual instruction, one can quickly identify at least five problems that largely account for the slow progress usually experienced in introducing new educational techniques. Stated briefly, these are: (1) problems with people (conservatism, suspicion, or indifference), (2) problems with environment (classrooms or other teaching spaces poorly adapted for audio-visual aids), (3) problems with equipment (poorly designed or poorly adapted for classroom use, generally inconvenient or difficult to use), (4) problems related to the availability of materials to be used with audio-visual devices, and (5) problems of cost and economic justification.

The problem of motivating professors to use audio-visual aids does not happen to be a major factor at Stephens College, and is a problem whose complete solution lies outside the jurisdiction of the "educational engineer." It should be noted, however, that the problem is not wholly independent of those in the other four categories. In defense of the teacher or professor who appears reluctant to employ audio-visual aids, it must be acknowledged that the difficulties frequently encountered in using such aids largely cancel their potential benefits. In the absence of a systems approach to teaching aids, it usually requires more time and effort to use an individual item of equipment than to accomplish the educational objective by some more "traditional" approach.

Responsibility for solving the problems related to the environment within which audio-visual aids are to be used rests primarily with school and college architects and their engineering consultants, although the role of administrators who establish the "boundaries" within which architects are free to work must not be underestimated. From the point of view of the communications engineer, the traditional college classroom is an almost incredibly poor instrument for the transfer of either aural or visual information, but significant improvements have been developed in the past decade or so. In the case of the James M. Wood Learning Center, a great deal of attention and effort has been directed to the task of providing favorable environmental conditions for audio-visual presentations, and for teaching and learning through a great variety of other techniques. Since the architectural design for the Learning Center was essentially completed before the beginning of this study, this report will not go into great detail on architectural matters.

Problems related to the equipment itself very clearly fall within the province of this study, as do the technological aspects of the problems of producing and distributing materials to be used with the equipment. The problems of cost and economic justification are also of direct relevance to this study, since the systems engineer in any field is obligated to consider economic factors no less seriously than technical factors. From an engineering point of view, audio-visual techniques (and other educational techniques, for that matter) are clearly justifiable only if they succeed in "getting the message through" from professor to student at lower cost or with a substantially higher degree of reliability than other methods.

Comments on the "State of the Art" in the Basic Media

It was suggested in Chapter 7 that there are only three "basic" audio-visual media: still pictures, motion pictures, and audio recordings. There are, however, literally hundreds of devices now available to support teaching activities through each of these basic media or combinations of two or more of them. One of the most serious problems facing any institution planning intensive use of audio-visual teaching aids is that of selecting a reasonable number of devices from the wide variety on the market.

Among the popular approaches to the display of still pictures are: (a) display of full-scale wall charts, with dimensions commensurate with the amount of detail to be shown and the size of the intended audience, (b) projection from opaque copy, usually through a 10 by 10 inch aperture, (c) overhead projection from relatively large transparencies, usually through a 10 by 10 inch aperture, (d) projection from slides, usually either 2 by 2 inches or 3¼ by 4 inches in size, and (e) projection from filmstrips, usually employing 35-mm film. (This study is not particularly concerned with such highly specialized projection devices as micro-projectors and shadowgraphs, which are generally limited to a few specific teaching applications.) Motion pictures are usually displayed at frame rates of either 16 or 24 frames per second from film that is usually one of three basic sizes: 35-mm, 16-mm, and 8-mm. In all cases, it is now possible to obtain sound tracks in either optical or magnetic form, and the aspect ratio (or ratio of width to height) that once appeared firmly standardized at 4:3 is now permitted to vary over relatively wide extremes, frequently requiring the use of anamorphic projection lenses. The most popular formats for recorded audio information (in addition to the sound tracks on motion picture film) are phonograph discs and magnetic tape, but there are wide variations in sizes, operating speeds, and track or groove configurations.

Each approach to any of the audio-visual media offers distinct advantages, but it should be possible for any college to standardize on a relatively small number of techniques (and the "hardware" needed to support them). Attempts to provide facilities to utilize all possible approaches to the same basic end are almost certain to lead to unnecessary duplication, confusion, and economic waste. The following comments may prove useful to readers of this report in evaluating the relative merits of the various approaches to each of the basic audio-visual media.

1. Wall Charts. In the judgment of the study team, full-size wall charts offer few advantages over the projected media in teaching situations (although they do offer advantages in unattended displays), and they suffer from the drawbacks of serious storage problems and relative inflexibility with respect to audience size. With modern photographic techniques, it is possible to capture in a relatively small area of film all the detail

normally required for a wall chart (in color, if necessary), and an overhead transparency or slide is far more convenient to use than a wall chart if appropriate projection equipment is readily available and set up for convenient operation. Thus, a college would be justified in adopting a policy of discouraging the use of large charts, urging professors to convert existing charts to either overhead transparencies or slides, and specifying one of these formats for all new material. There will always be reasonable exceptions, of course, but a college that has made a policy decision in favor of projected media over wall charts need not feel obligated to equip classrooms and offices with facilities for using and storing large charts.

2. Opaque Projectors. If it were not for an unfortunate technical "fact of life," the opaque projector could be one of the most versatile and valuable of all teaching aids. The ability to project on a screen enlarged versions of any information typed, printed, handwritten, or drawn on ordinary paper (as well as opaque photographic materials) is certainly desirable, and it is difficult to see how the cost of materials could be reduced much below the level required for the opaque projector. The unfortunate technical fact is, however, that opaque projectors can produce only dim pictures relative to other projection devices employing lamps and screens of comparable sizes. This problem does not arise from poor technical designs, but from the inescapable fact that opaque materials absorb a great deal of the light that falls on them and effectively "scatter" the rest, permitting relatively little of the incident light to pass through the objective lens which forms the image on the screen. Even with 1,000-watt light sources (the largest size normally considered practical

for use on ordinary lighting circuits), the typical opaque projector produces a classroom-size picture of such low light level that almost complete room darkening is required to obtain reasonable contrast. Such complete room darkening is not only difficult to achieve, but it also impedes the communications process by preventing effective eye contact between teacher and students and by making note-taking very difficult. The light-scattering properties of opaque materials leads to a further drawback in the design of opaque projectors: to keep the stray light escaping from the projector within reasonable limits, it is necessary to enclose the opaque materials in essentially light-tight boxes, usually resulting in relatively awkward loading arrangements and preventing the use of simple pointers or pencils to add lines or notations to materials while being projected.

Because of these technical difficulties, the study team recommends that the use of opaque projectors in college teaching be discouraged. Thanks to recent developments in photography and other copying techniques, it is now easy and relatively inexpensive to convert almost any kind of opaque material to either slides or transparencies--formats which permit much more efficient teaching. It is also possible to employ small television cameras in special teaching desks to make effective use of opaque visual materials; this possibility is discussed in greater detail in Chapter 9.

3. Overhead Projectors. During the past decade, the so-called overhead projector has gained wide recognition as a highly effective and versatile teaching tool. The typical overhead projector has a 10 by 10-inch working aperture mounted horizontally (or nearly so) with light coming from beneath to illuminate either pre-

prepared transparencies or sheets of clear plastic material on which a lecturer may draw or write with a suitable pencil or pen. The projector is normally placed beside the lecturer at his normal teaching position, so arranged that he can write or draw on the working surface or manipulate transparencies while facing the class. An enlarged image of the working aperture appears on a screen a few feet behind and above the instructor; projection is accomplished by a lens and mirror combination mounted a foot or so above the working surface. The instructor normally stands to one side so that the light beam passes over his shoulder to the screen. Because of the large aperture and the use of transparent materials, it is relatively easy to design overhead projectors with sufficiently good optical efficiency to permit operation under relatively high levels of room lighting.

Transparencies for use with the overhead projector are commonly prepared on 8½ by 11-inch sheets of material which, when mounted in frames of cardboard or similar material, yield useful images of about 8 by 10 inches. This image size is great enough that no special viewing devices are required for inspecting or studying nonprojected transparencies, and yet small enough to permit the filing of transparencies in ordinary drawers and file cabinets. The image size also permits normal handwriting, printing, or drawing on a transparency under full view of even a large audience. In fact, an overhead projector equipped with a roll of transparent material arranged to pass directly over the working aperture serves as a highly effective substitute for the traditional chalkboard. As the image area becomes filled with written material or sketches, the used portion of the roll of transparent material may be moved out of sight (usually beyond the top edge of the image), so that an extensive amount of "board work" can be done during any class period without having to erase previous material. Still other accessories and special materials are available to increase the versatility of the overhead projector. Transparencies can be built up in layers, with "overlays" added to a basic drawing or chart to emphasize teaching points one at a time. It is also easy and relatively inexpensive to add color to transparencies through the use of multiple layers which are prepared separately. Special carbon papers are available which make possible the apparent writing of white lines on a black surface. A variety of animation effects can be achieved through the use of polarized materials with transparencies in association with a motor-driven disc of polarizing material placed in the light path. Many real-life objects can be used to form "shadowgraph" displays, and "projectable" working models of various types can be constructed of colored or transparent plastics. With some types of office copying machines, it takes only a minute or less to convert any written document (such as a theme written by a student) into a transparency, permitting convenient inspection and discussion of written material by an entire class.

The overhead projection technique is not without disadvantages, however. To avoid "keystoning" of the image, it is usually necessary to tilt the screen rather severely to keep the optical axis of the light beam at right angles to the screen surface; the screen must either be of a rigid type or held in a rigid mounting that is difficult to retract quickly when the projector is not in use. In some classroom environments (especially those not designed for audio-visual aids), the "throw distance" required for the projector may reduce the space available for student seating, and it may not be possible to provide clear sight lines to the screen from all seats without interference from the top of the projector and the instructor himself. Unless the projector is mounted in a proper type of teaching desk or console with suitable light shields, there may also be a serious glare problem, especially in situations where it is necessary to tilt the projector itself slightly toward the audience to provide a proper optical path to the screen. While most instructors find the overhead projector easy to use, and the direct control the instructor exercises over the projection conditions is basically desirable, presentations of unusual complexity may require so much manipulation of material that the instructor's attention is seriously diverted from his subject matter. The use of an assistant or technician to manipulate an overhead projector is not too practical (because of its location in full view of the audience), so it is probably wise to turn to alternative projection techniques when very complex presentations are required.

In summary, the overhead projection technique deserves serious consideration as one of the most useful audio-visual tools for college teaching. More than just another means of projecting still pictures, the overhead projector offers valuable opportunities to manipulate or develop visual materials in full view of an audience.

4. Slide Projectors. In contrast to the opaque projector and overhead projector, the slide projector can normally be used only in situations where needs have been anticipated far enough in advance to allow time for photographic processes in the preparation of materials. Once prepared, however, a set of

slides becomes a relatively permanent teaching or learning resource that can be used very conveniently if appropriate projection facilities are made available on a systematic basis.

The study team recommends that any college desiring to encourage the use of slides take steps to standardize on a single size, on a single type of tray or magazine for automatic projectors, and on a uniform type of mounting or binding. As noted earlier, the two most popular sizes are 3¼ by 4 inches and 2 by 2 inches. The former standard is still widely used in many colleges, but appears to be on the decline in favor of the latter. The larger size became popular at a time when the image quality obtainable in smaller formats left much to be desired, and when the "state of the art" in optical systems gave the larger size a substantial advantage in screen brightness. In recent years, however, the quality of photographic emulsions used in 35-millimeter films has become more than adequate and refinements in lamps and optical systems have made possible highly satisfactory projection of 2 by 2-inch slides even in very large auditoriums. The 2 by 2-inch slides are now substantially lower in cost than 3¼ by 4-inch slides, require far less storage space, and lend themselves more readily to automatic equipment designs.

The study team strongly endorses the use of remotely-controlled slide projectors employing trays, cartridges, or magazines for the preloading of slides. Such devices permit an instructor to assume complete control of the projection situation, taking responsibility for arranging and orienting the slides in advance, turning the projector off and on at the desired times, and changing the slides at the optimum moments. (To achieve truly complete control, the instructor should also be able to adjust the room lighting from his normal teaching position.) Unfortunately, it is not easy to make a choice among the many types of remotely-controlled projectors and the trays, cartridges, or magazines required for use with them. In making such a choice, a college should consider such factors as the cost, size and weight of the trays or magazines, the number of slides accommodated at each "loading," the ease of rearranging or editing slides (which may involve a compromise with the hazard of spilling), optical quality of the projection equipment, duration of the slide-change cycle, freedom from jamming or other mechanical problems, acoustic noise from the equipment, and the degree of remote control available. It is desirable to provide remote control of the lamp (off-on) and of slide changes in either direction (to permit return to previous slides). Unless the mounting and emulsion position of the slides to be used are firmly standardized, it is also desirable to provide remote control of the focus adjustment. Slide projection equipment should also be designed to permit automatic synchronization with recorded audio materials; if the slide advance function is controlled by a simple contact closure, it is usually possible to provide such automatic synchronization by an external "trip-cue" device which utilizes cue tones recorded along with the audio material.

Colleges are urged to regard slide projection facilities as systems--to provide essentially the same facilities in all teaching spaces where slides are to be used, and to provide "built-in" provision for screens, power connections, and remote controls. The setting up and operation of a slide projector should never become a major project for the instructor or his assistant. While highly satisfactory results can be achieved with some of the best "hardware" now available, it is quite possible that truly optimum facilities for slide projection in educational institutions have yet to be developed. Most of the devices now available appear to have been designed primarily for use in the home, and creative engineers should find many opportunities for developing improved slide-handling devices which meet the specific needs of education.

5. Filmstrip Projectors. The filmstrip projector is not sufficiently versatile to replace the slide projector as an audio-visual teaching tool, but in some situations it provides significant economic advantages. In general, the use of a filmstrip projector is desirable in teaching situations where the information to be presented has been so thoroughly processed that a fixed sequence of visual material has been firmly established, and multiple copies of the visual material are required. Of the several media reviewed thus far, the filmstrip comes closest to representing "packaged instruction"--teaching "messages" in recorded form, usually originated by a teacher other than the one who actually faces the class. In cases where filmstrips are used in association with recorded audio materials, the "packaging" becomes even more complete.

The economic advantages of the filmstrip technique arise primarily from the fact that no mounting arrangements are required for individual pictures. The film itself (usually of 35-mm size) serves as the sole physical support for the sequence of pictures, and the absence of bulky mounting frames makes possible very compact storage. Once a "master negative" is made for a filmstrip, additional prints can be produced at relatively low cost (although few colleges can justify the investment in 35-mm printing and processing equipment--such work is normally done by commercial film laboratories). The image size commonly used for 35-mm filmstrips occupies only half the area normally used in 2 by 2-inch slides, but corresponds to that used in standard 35-mm motion-picture projection, and hence provides very satisfactory image quality. Because the film material itself is subject to considerable handling, the quality of filmstrip images may be impaired by scratches and other types of physical damage, but this problem can be kept under reasonable control by insisting on reasonable care in handling and strict cleanliness in projection equipment. Remote controls for filmstrip projectors may reasonably be simplified relative to those required for slide projectors. It is desirable to provide remote controls for the "off-on" function and the "picture advance" function, but the very nature of filmstrip material makes a "picture reverse" control less necessary (although it may still be desirable to compensate for operator errors), and the fixed emulsion position of any given filmstrip effectively eliminates the need for remote focus control. Provision for automatic synchronization with recorded audio materials is probably even more important for filmstrip projectors than for slide projectors.

In college teaching, the filmstrip projection technique deserves consideration primarily as a means of taking advantage of low-cost recorded instructional materials brought in from outside sources. Filmstrips may also play a prominent role in true audio-visual "libraries" in which it is desired to give students direct access to recorded audio-visual materials. The advantages of tamper-proof sequence, low print cost, and compact storage space are of significant value in such "library" applications, and small viewing devices suitable for use by individuals or small groups are readily available.

6. Motion Pictures. It is quite unnecessary, in the context of this report, to comment in detail on the potential roles of motion pictures in education. Sound motion pictures in full color permit highly effective communication through both sight and sound, and even silent pictures in monochrome can be extremely useful. Motion-picture techniques can be used both to present entire instructional programs, and to present or illustrate specific points through brief "single-concept" films that are integrated into other presentations. It should be noted, however, that the production of films requires even more advance preparation (and money) than the production of slides or filmstrips.

   From an "educational engineering" point of view, there is substantial room for improvement in most of the equipment presently available for motion-picture projection. The quality of projected images and reproduced sound may be quite satisfactory in many instances, but the typical film projector is relatively difficult to set up and operate, and it develops enough acoustic noise and stray light that its presence in the classroom is a fairly serious distraction. In new construction, these problems can be minimized through the permanent installation of remotely-controlled projectors, either in rear-projection arrangements or in enclosed projection booths. Unfortunately, this approach is relatively space-consuming and expensive, and is not too practical for many existing classrooms. An approach that has been given all too little attention is that of refining the equipment itself. While notable progress has been made in the development of self-threading machines, most of the projectors used in education are still essentially nothing more than adaptations of devices designed primarily for use in theaters. To encourage more widespread use of motion pictures in classrooms, cartridge-loaded projection equipment with highly-refined sound-deadening treatment should eventually be developed. The design problems involved are not easy, and the cost of cartridge-loaded equipment is almost sure to be higher than the conventional equipment in use today, but as the use of film gains greater acceptance in education, manufacturers may obtain the incentive needed to justify the major investments involved in totally new equipment designs.

Until quite recently, 16-mm film was widely recognized as the "standard" size for educational applications. During the past several years, however, there has been an upsurge of interest in 8-mm film for use in education. It is now possible to produce magnetic sound tracks on 8-mm films, and experimental work is in progress on optical sound tracks for 8-mm films. In spite of the tiny image area of 8-mm films (approximately one-fourth that of 16-mm images and one-thirty-second that of most 2 by 2-inch slides), the image quality obtainable with good photographic emulsions is adequate for many instructional applications, comparing rather favorably with the picture quality obtainable in typical mass-produced television receivers. The problem of directing intense light rays through the tiny aperture normally limits the maximum picture size obtainable with reasonable brightness from an 8-mm projector to something like 3 by 4 feet, but this is adequate for many classroom applications. While projection equipment for 8-mm films may be expected to cost somewhat less than comparable equipment for 16-mm film, it should be noted that the mechanical precision required in the intermittent mechanism becomes greater rather than less as the image size goes down if the performance with respect to picture steadiness is to remain the same. The small size of 8-mm films is a significant advantage in the design of cartridge-loaded projection equipment. For long-term storage and "library" use, 8-mm films offer space and weight advantages relative to 16-mm film, but only at a significant sacrifice in picture quality.

At the time of this writing, it is not possible to predict accurately the degree to which 8-mm film may replace 16-mm film in educational applications. Many of the hoped-for economies in the use of 8-mm films can be achieved only if a demand can be built up for substantially larger quantities of prints and projectors than has been characteristic of the 8-mm activity to date.

7. Audio Recordings. The two most popular media for audio recording and reproduction are the phonograph disc and magnetic tape. Each medium offers such strong advantages that it is probable that both will be used in education for many years to come. The chief virtue of the disc record is the low cost resulting from the stamping methods used in its manufacture, but the disc record also permits very rapid access to brief sections of audio material incorporated in longer recordings and requires no "re-wind" time. Because of the fine grooves used in modern disc records, they can be damaged by careless handling, but this problem is not too serious in the college environment if records are used by mature students with a reasonable sense of responsibility. Magnetic tape is recognized as an almost ideal medium for "do-it-yourself" recordings; tape recorders have been refined

to the point where virtually no technical training is required to produce recordings of excellent quality.

One of the problems involved in utilizing disc recordings is the multiplicity of speeds and groove dimensions. The 78.26 rpm speed that was "standard" for a great many years has now become obsolete to the degree that it can probably be ignored in most new installations of audio-visual teaching systems. (This also eliminates the need for pick-up cartridges with the 3-mil stylus required for 78 rpm records). The vast majority of records of interest to educators are now available on 33-1/3 rpm discs, so this speed probably comes closest to being a "universal" standard for educational use. 45 rpm records are made only with a large center hole and 7-inch diameter, and are best adapted for relatively brief selections of music and other recorded material, especially where it is desired to handle the records on automatic changers. 16-2/3 rpm records are generally limited to such specialized applications as "talking books."

During the past few years, stereophonic recordings at the 33-1/3 speed and instruments for playing them have become widely available. Such recordings have grooves which record information in two dimensions simultaneously (crudely speaking, the two independent signals required for a stereophonic reproduction are recorded on the two sides of the groove), and must be played with a stylus having a tip radius of 0.7 mil in contrast to the tip radius of 1.0 mil normally used for ordinary "microgroove" recordings at the standard speeds of 33-1/3 and 45 rpm. Because stereo recordings can be ruined by attempts to play them with a 1- mil stylus, it is good practice for institutions planning extensive use of both types of recordings to equip every record player with a stylus of 0.7-mil radius, which will give satisfactory performance for both monophonic and stereo recordings. Of course, when a stereo recording is played on monophonic equipment the stereo effect is not achieved. When a monophonic record is played on stereo equipment, it is considered good practice to connect the two channels from the pickup cartridge in parallel to cancel the effects of unwanted vibrations of the stylus.

The magnetic tape used for audio tape recording is almost always 1/4 inch wide, but a variety of speeds and track configurations are used for various applications. In general, high speeds are used to obtain extended high-frequency response and maximum smoothness of motion (to minimize the distortions known as "wow and flutter"), and wide tracks are used to obtain "stronger" signals, needed for good signal-to-noise ratios (freedom from "hiss"). In the early days of tape recording, "high fidelity" or broadcast-quality recordings were customarily made at a tape speed of 15 inches per second with a track extending across the full width of the tape. Recent refinements in machines and tape coatings have now made possible good "high fidelity" recordings at tape speeds of 7.5 inches per second with tracks slightly less than half the width of the tape. The great majority of tape recorders now available for home or school use have so-called "half-track" recordings or playback heads, and give the user a choice of two speeds, usually 7.5 and 3.75 inches per second; recordings at the lower of these speeds are fully satisfactory for ordinary speech, but often have noticeable degradation in the reproduction of music. Stereo recorders may operate with either dual half tracks, or tracks that are a little less than one-fourth of the width of the tape. Most pre-recorded stereo tapes have so-called "quarter tracks," arranged so that one pair of tracks is opposite the active heads when the tape is passed through the machine in either direction. Some tape recorders, especially those designed in ultra-compact form for portable use, operate at tape speeds of only 1-7/8 inches per second; most such machines are intended only for speech recording where maximum fidelity is not too important.

Cartridge-loaded tape recorders of several basic types are now available, and offer significant advantages in ease of operation. Some cartridges are of the continuous-loop type, while others employ two hubs arranged so that the tape passes from one to the other. "Libraries" of pre-recorded music (usually stereo) are now available for at least two types of cartridges, although the selections available are not nearly as extensive as in the case of disc records. It is still too early to predict which of the existing types of cartridges (if any) may eventually become a widely-accepted "standard" for educational use. Most of the cartridge-loaded machines now on the market are designed primarily for home use, although a few types have been developed specifically for use in language laboratories, and high-quality cartridge-loaded machines are widely used in broadcast stations for commercial announcements and similar brief "programs." A good cartridge-loaded machine designed specifically to fit educational requirements could become a very basic "building block" for a wide variety of educational electronic systems, but the study team feels that the truly optimum machine of this type is yet to be developed.

Specific Recommendations for the Stephens College Learning Center

Even before the study reported here was initiated, the staff of Stephens College had decided to encourage the use of audio-visual aids in the Learning Center by installing in most of the classrooms and other teaching spaces a standardized form of audio-visual control panel, located near the instructor's normal teaching position. The architectural design for the Learning Center includes projection booths for several large-group instructional areas, and conduits are provided for circuits from the audio-visual control panels to projection and audio devices in these booths. In the smaller classrooms where space for projection booths could not reasonably be provided, the plans include conduits between the audio-visual control panels and "projector connection panels" at the back of the room. To minimize the initial capital investment in equipment, Stephens College planned to utilize portable equipment, mounted on suitable dollies or mobile consoles for convenient operation, and designed for plug-in connection to the permanently-installed control panels. The recommendations reported here are heavily based on these initial plans of Stephens College, but also reflect the systems engineering investigations made by the study team. It is assumed that readers of this report are not particularly interested in who deserves the credit for each specific idea, but it should be made clear that the facilities finally installed at Stephens College were planned through the combined efforts of the Stephens College staff, their architects and other consultants, and the RCA study team.

For the sake of brevity, the recommendations of the RCA study team in reference to audio-visual facilities for the Learning Center are presented below in itemized form. Technical details are presented in Alternates A, B, and G of the specifications appended to this report as Appendix A, and cost data are presented in Chapter 13.

1. It is recommended that Stephens College standardize on the following audio-visual teaching aids: overhead projectors, utilizing 10 by 10-inch apertures; projectors for 2 by 2-inch slides; projectors for 35-mm filmstrips, projectors for 16-mm motion-picture film; record players for 33-1/3 rpm disc recordings, both monaural and stereo; tape recorders and reproducers arranged to handle either half-track monaural or dual-half-track stereo tape recordings, with provision for playback only of dual-quarter-track stereo recordings. All projection equipment with the exception of the overhead projectors should be designed for remote control, and provision should be made for "trip-cue" devices to operate either the slide or filmstrip projectors from cue tones originating from either record players or tape recorders.

2. It is recommended that the systems engineering required to assure that all items of audio-visual equipment are compatible with each other and with the proposed built-in control facilities be assigned to a single supplier, who shall then become responsible for selecting the specific brands or types of equipment which best fit the requirements of the system. (All such decisions must, of course, remain subject to approval by Stephens College).

3. It is recommended that 8-mm film equipment and cartridge tape equipment be regarded as potentially useful audio-visual aids, but still in the experimental stage. It would be appropriate for Stephens College to acquire limited quantities of these items for evaluation, but a firm commitment is not recommended at this time.

4. It is recommended that all teaching spaces be connected to the television and audio distribution systems (discussed elsewhere in this report) to permit use of audio-visual materials which may be required in more than one room simultaneously.

5. It is suggested that permanent facilities for all of the recommended media be installed in the large-group teaching spaces where projection booths are available (the Assembly Hall, Cinema Laboratory, and Multi-Purpose Room), and that the sound facilities in these rooms be designed for optional use as origination points for audio programs. Control facilities for lighting and for audio-visual aids in these rooms should be integrated into lecterns, with provision made for convenient movement of the lecterns to suit various program requirements. The permanent sound systems in these spaces should be designated for the reproduction of stereo program material. In only one case (the Assembly Hall) should it be necessary to provide permanent speech reinforcement facilities (requirements for which differ substantially from the requirements for reproducing recorded speech or music). In other cases where speech reinforcement may be required only occasionally, a portable "electronic lectern" with built-in amplifying system is recommended. Multiple screens to permit simultaneous use of at least two picture displays in each large-group area are recommended, and a tilted screen suitable for overhead projection should also be provided in each room.

6. It is recommended that the permanently installed facilities in each classroom where audio-visual aids might be used include: a projection screen, a stereo sound system, a remotely-controlled television receiver, a signal selector for the main audio distribution system, an audio-visual control panel near the instructor's normal position (probably wall-mounted), and a projector-

connection panel at the rear of the room. The audio-visual control panel should include means for controlling the room lighting to establish proper lighting conditions for either routine classroom activities or the viewing of projected pictures. Provision should also be made for the rapid installation of the tilted screen required for overhead projection.

7. To encourage faculty members to accelerate their use of audio-visual aids, it is suggested that the overhead projection technique be singled out for a preliminary "saturation campaign" to be inaugurated as soon as the Learning Center is opened. It is suggested that overhead projectors, mounted in suitable teaching consoles with adequate storage spaces and working surfaces, be provided in at least 12 of the 15 classrooms in which audio-visual control facilities are to be installed. These projectors should be equipped with rolls of transparent material, and faculty members should be given every encouragement to use them in preference to conventional chalkboards. The overhead projection technique is recommended for this preliminary campaign because it requires the minimum change in work habits relative to the traditional methods of teaching. As part of this campaign, it is recommended that Stephens College provide facilities to make the production of pre-prepared transparencies for the overhead projector as convenient as possible, thus encouraging professors to bring visual materials to class, instead of relying as heavily as in the past on chalkboard outlines and sketches. Specific suggestions for the production facilities are presented in a later section of this report. If they are properly planned, professors should soon discover that they can save work for themselves by developing visual materials which can be used repeatedly, and which can also be made available to students (possibly through additional

reproductions) as learning resources. One of the virtues of the overhead projection technique is that the projected materials themselves are large enough to be read comfortably by individuals or small groups without optical aids. As a further step in encouraging visual approaches to teaching, it would be very appropriate for each department housed in the Learning Center to establish a display area, probably near the department offices, where the overhead transparencies associated with current lecture or discussion topics might be displayed in simple rear-illuminated panels for convenient reference by students. As professors come to think of themselves as "developers of learning resources," they should become motivated to prepare visual aids that will be useful as reference materials for students as well as teaching aids for themselves. If this "saturation campaign" for the overhead projector is successful, it might well be extended into other areas, such as slide projection or film projection, but providing convenient facilities in advance of the actual demand for them.

8. It is recommended that record players and tape recorders for use in Learning Center classrooms be mounted in mobile teaching consoles, designed to harmonize with the special consoles used for the overhead projectors. These consoles should be equipped with plug-in connectors for rapid connection to the built-in audio-visual control panels, should be mounted on wheels or casters, and should be small enough to pass readily through classroom doors. Each console should also be equipped with a trip-cue unit permitting slide or filmstrip projectors to be synchronized automatically with recorded audio materials. The study team agrees that the quantity of six such consoles planned by Stephens College prior to this study is reasonable for the initial operation of the Learning Center.

9. It is recommended that slide projectors, 16-mm film projectors, and filmstrip projectors be mounted on mobile stands or dollies at the proper height for good projection in any of the classrooms. The dollies or stands should have provision for mounting at least two projection devices simultaneously, and should have storage spaces for all accessories normally associated with projector operation. All equipment should have plug-in connectors compatible with those provided in the permanent projector connection panels. Quantities of six of each type of projector appear reasonable for the initial facilities.

Facilities for the Production of Audio-Visual Materials

Facilities for the production of audio-visual materials on a college campus may be divided into two basic categories: those intended for use by professional artists, photographers, technicians, and other staff specialists who devote essentially full time to the production of materials, and those intended for use by faculty members who devote only a small part of their time to such activities. In the James M. Wood Learning Center, the major facilities in the former category are the radio, television, and film studios and the related work rooms for graphic arts and photography, all of which are reviewed in later sections of this report. The study team feels that additional facilities in the latter category may be of major benefit in stimulating faculty members to make optimum use of the audio-visual presentation facilities proposed for the Learning Center. While the typical college professor may not have a significant amount of artistic talent, there are so many convenient mechanical aids for lettering and drawing now available that it is often almost as easy to turn out a professional-looking "visual" as it is to communicate one's ideas to a professional artist, provided the proper facilities for utilizing these new mechanical aids are readily available. Likewise, it is now possible for almost any professor to turn out high-quality audio recordings with little effort, provided he has access to a good tape recorder, a high-quality microphone, and a reasonable acoustic environment.

It is recommended that basic facilities for producing 10 by 10-inch transparencies and 2 by 2-inch slides be provided at approximately 10 different locations within the Learning Center, adjacent to faculty offices. As a "rule of thumb," it is suggested that one such facility be provided for every 6 to 10 faculty members, with the exact ratio determined by departmental organization structures, the physical location of offices, and the anticipated level of use. Each such basic facility might include: a copying device for producing transparencies (also useful for routine office copying); a drawing board and basic drafting instruments, including felt pens, tape pens, and lettering guides; several types of movable letters; a reflex-type 35-mm camera in a suitable copy stand; a cutting board; a supply of poster board and other art materials; and facilities for mounting, previewing, sorting, and editing slides and transparencies. Much of the routine work involved in using these facilities might be assigned to secretaries or stenographers, but it should be made as easy as possible for a professor to lay out exactly what he wants on the final "art-work" to be copied or photographed. These decentralized facilities should be "backed up" by a centralized production service, probably the same group which serves the radio-TV-film production area. A small staff of professional artists and photographers could handle production assignments which exceed the talents or time availability of professors, and could also handle problems of duplication or processing to transfer materials from one medium to another. It would be important, of course, to provide prompt development service for color slides, either "on campus" or through a reliable local company.

To encourage professors to develop recorded audio resources for their students, the study team recommends that an audio recorder of reasonably high quality be assigned more or less permanently to every professor who expresses willingness to use one. Ideally, it should be possible for any professor to utilize his own office as a "recording studio" to produce simple audio commentaries to accompany filmstrips or sets of slides, or to produce "audio essays" for use as learning resources. The degree of sound isolation that should be provided in faculty offices for student counseling and for study requiring great concentration should also be adequate for producing good voice recordings with a close-talking type of microphone. Unfortunately, the acoustic design of faculty offices is given all too little attention in many colleges, so it is necessary to determine by experiment whether satisfactory recordings can be made in any specific office. It should always be possible, of course, for a professor to arrange for the use of one of the radio studios when he intends to produce an audio recording requiring the highest quality and professional "polish." To facilitate the production of audio recordings with trip-cue tone signals for the automatic synchronization of the recordings to sets of slides or filmstrips, professors should have convenient access to appropriate trip-cue tone generators and slide or filmstrip viewing devices for use during the recording operation. The actual operation of the trip-cue tone generator should involve nothing more than pushing a button at the appropriate instant .

Teaching and learning aids on motion-picture film could be produced by direct film photography either in the film studio of the Learning Center or "on location" elsewhere. While motion picture production is relatively time-consuming and expensive (compared to the production of slides and overhead transparencies), Stephens College would be well advised to make it possible for professors with any inclination to use a motion-picture camera to borrow one for appropriate periods. Where economy and speed are important, and where monochrome prints are satisfactory, professors should be encouraged to utilize television production facilities and television recorders to produce either complete programs or brief audio-visual presentations.

Chapter 9

FACILITIES FOR THE PRODUCTION AND RECORDING OF TELEVISION, AUDIO, AND FILM PROGRAMS

The Potential Roles of Television on the College Campus

As a prelude to discussions of the program-production facilities recommended for the James M. Wood Learning Center, it seems appropriate to review briefly the reasons for providing such facilities. Television is undoubtedly the most versatile of the media to be discussed in this chapter, and there are many schools of thought now in existence concerning the proper role of "educational television." To minimize confusion on this point, the study team considers it important for the readers of this report to understand that television is capable of playing at least five relatively distinct roles, each of which should be judged on a somewhat different basis. In the following summary, the educational significance of each role is reviewed, along with comments on the basic character of the facilities required to support each role.

1. Mass Communications. To most of the lay public, television is known primarily as a broadcast medium for bringing entertainment, news, advertising messages, and educational materials directly into the home. Any college seeking to prepare students for modern living must acknowledge the existence of broadcast television, and should provide reception facilities in at least a few locations on the campus if for no other purpose than to permit students and faculty

members to view news, current affairs, and cultural programs. Under proper direction, broadcast reception facilities can also be useful in teaching students to discriminate between good and bad programs, to judge contemporary drama, to become acquainted with the personalities, speaking techniques, and activities of prominent people, and to observe the role of advertising in American life. Those students planning careers in the broadcast industry should be given opportunities both to observe and to participate in the production of television programs, utilizing facilities typical of those actually used in the industry. Television as a mass communications medium is also potentially useful to any college as an instrument for public relations or "extension" activities. While the operation of a full-fledged broadcast station may be beyond the means of a small college like Stephens, almost any college can produce at least one or two programs per week of sufficiently good quality to be broadcast by a nearby commercial or educational station. While many stations are happy to supply studio facilities and basic production personnel to college groups for occasional programs, the amount of rehearsal time such stations can provide is normally quite limited; ownership of at least modest television production facilities gives any college opportunities to improve the quality of its public-relations and extension programs.

2. Observation. There are many educational applications for television as an observational medium. For example, small, closed-circuit television systems can be used as demonstration aids to permit all students to obtain clear views of very small objects. Television cameras can be coupled to other

optical devices, such as microscopes, and can also be used either to enlarge or to "multiply" (through multiple receivers connected to the same camera) such instruments as oscilicscopes and meters. A television camera with a zoom lens mounted over a teaching desk forms a teaching tool that is comparable in many ways to the overhead projector, but with even greater versatility, thanks to its ability to pick up images of either opaque or transparent materials. On a larger scale, closed-circuit television is an excellent tool for such applications as the unobtrusive observation of classroom routines by student teachers, or the observation of subjects undergoing psychological tests. Coupled to a television tape recorder, a television camera becomes one of the most effective instruments for self-observation ever developed--potentially very useful in the learning of any complex skill from athletics to orchestra conducting.

The facilities required for observational applications of television vary greatly with the specific objectives to be accomplished. In many cases, the low-cost closed-circuit systems designed primarily for industrial monitoring applications are suitable for observational purposes.

3. Program Production. Television deserves consideration as a production medium in its own right--similar in many respects to motion-picture film, but very different in several other respects. Television facilities for program production normally include multiple cameras and electronic editing equipment, ranging from simple switchers permitting only direct "cuts" to very elaborate facilities

permitting lap dissolves, superimpositions, and a wide variety of split-screen and inset effects. This electronic editing equipment, along with the possibility of simultaneous monitoring, gives television a major economic advantage over film, in spite of the substantially larger capital investment required for a television studio as compared to a film studio. The use of television monitors or picture displays in the control room as well as on the cameras themselves permits the program director to inspect each "shot" as it is produced, giving him 100% assurance that the lighting, exposure, framing, and focus are correct. Thanks to the "instantaneous editing" made possible by electronic equipment, it is common practice to produce even highly complex television programs in "real time." (That is, the actual "shooting time" for a 30-minute television program may be only 30 minutes, assuming adequate preparation beforehand.) In motion-picture practice, on the other hand, the production cycle for a single program typically extends over many days or weeks, and costs rise far above those required for a comparable television production. Only one person at a time can see the image in the usual optical viewfinder coupled to a film camera, and it is common practice to "shoot" a great deal more film footage than actually required to assure adequate material for later assembly of the program in the film editing room. It is significant that most television production studios include at least one "film chain" permitting convenient insertion of either film or slides into television programs. Thus, the major advantages of film (such as highly portable camera equipment, and the apparent compression of time) can be retained in television production.

In the field of education, intelligent use of television as a production medium begins with the recognition that the television system itself imposes many conditions which are very different from those encountered in "live" classroom teaching. The simple use of television to transmit pictures of a professor delivering a conventional classroom lecture should probably be considered an *observational* application of the medium, rather than a *programmed* application. If each program is carefully planned to compensate for the limitations of the medium and to take full advantage of its new opportunities, the quality of instruction can be significantly improved. A major factor contributing to this improved instruction is the *specialization* made possible by a revision in the economic conditions of education. Through television, it is possible to reach enough students with a given program that it becomes economically practical to permit a professor to spend much more time preparing the program than would ever be considered reasonable for a conventional classroom lecture. Where television is used intensively (on a level which justifies the financial investment), studio teachers have opportunities to specialize in the presentation aspect of teaching, while classroom teachers have greater opportunities to specialize in individual counseling.

4. *Program Storage*. In some instances, the chief justification for using television in education may be the opportunity to record instructional materials for later use. Some of the educational benefits of such recorded instruction were reviewed in Chapter 6. In brief,

television recordings can be used to conserve the effort and extend the influence of professors, and to make instructional materials more readily accessible to students when "live" professors might not be available. Through the use of magnetic tape, television programs may be recorded and played back almost immediately at nominal cost. Through the use of television film recording (or kinescope photography), television programs may be stored in a form which permits their use either via television or via direct optical projection.

5. Distribution. In addition to its other roles, television serves as an excellent distribution medium for audiovisual materials. (In a sense, the use of television as a mass communications medium illustrates its effectiveness as a distribution medium in the specialized case where the major audience is the general public.) Through the use of multiple receivers, it is technically possible to present a single audio-visual program to a virtually unlimited audience. This distribution potential of television is another of its significant economic advantages over motion-picture film. Without television, the multiple prints required to permit a film program to be seen at about the same time by a large, geographically-dispersed audience represents a major cost factor. It is significant that what is transmitted in a television system is actual information, not physical materials. In the great majority of ETV projects, the distribution role is at least as important as the production role. On the college campus, television is employed as a distribution medium when it is used to interconnect a number of classrooms for a common learning experience, when film materials are distributed from a central projection room to multiple classrooms,

or when a multiple-channel system is used to give individual students access to a variety of audio-visual materials.

Audio Communications on the College Campus

Interestingly enough, the five basic roles reviewed above for television also apply, with slight changes in terminology, to audio communications. The specialized branch of audio communications known as radio deserves consideration, along with television, as a major mass communications medium. While the word observation does not apply to audio facilities, an analogous function is that of monitoring or "electronic eavesdropping"--audio facilities can be used to "listen in" on events happening in distant places. The word radio also connotes an important program production medium, suitable for a wide variety of subject materials including music, drama, comedy, literature, religion, and, of course, instruction. While the attention once devoted to radio program production has now been greatly overshadowed by television, audio programs remain potentially valuable for both broadcast and closed-circuit applications. Recording plays an important role in audio program storage, just as it does in television, and electronic facilities can be used for the effective distribution of audio materials.

When compared directly to television, audio communications must be rated second best in total effectiveness because of dependence upon a single sense (hearing) rather than the two senses (sight and hearing) involved in television. On the other hand, audio communication facilities are far less complex (and thus far less expensive) than television facilities, so the "effectiveness per dollar" (if only there were some realistic way to measure this characteristic) may actually be superior to television. Educational research has not yet succeeded in defining exactly the relative significance of sight and hearing in the learning process, although common sense alone indicates that improved learning opportunities are provided by simultaneous use of the two senses. Some studies suggest that sight is by far the more important learning sense, but it is significant that the book has never made obsolete the classroom or the lecture hall, even though the vast majority of the content of most classroom or lecture-hall presentations is available somewhere in printed or other visual form. In a great many college lecture halls, the sense of hearing is relied upon almost exclusively for the transfer of information--vision contributes to understanding only to the degree that the student can see well enough to observe gestures and subtle facial expressions that help to convey meaning. On the other hand, complete removal of the professor from the lecture, and substitution of his voice coming through a loudspeaker may have an adverse effect on the learning process. (As far as the study team is aware, this point has not been proved one way or the other.) Common sense indicates that visual attention must be directed somewhere (since closing the eyes tends to induce sleep), and even the image of a person expressing the words one is hearing may be more conducive to learning than a visual experience with no direct connection whatsoever to the desired learning experience.

In spite of the fact that audio communication facilities of high quality have been available for many decades, the study team feels that relatively little progress has been made in utilizing them effectively in education. Where purely verbal information is involved, it must be acknowledged that audio communication facilities require more time for the transmission of a given body of information to a student than does the printed page (since oral reading is invariably slower than silent reading), but efficiency in transmission is not necessarily equivalent to efficiency in learning. It may well be that a student can be helped in his understanding of text materials by simultaneously listening to a good teacher read and interpret the material. Many types of materials lend themselves to audio dramatization (which can be produced at significantly less cost than audio-visual dramatizations), and authentic sounds may be important in learning many subjects that do not lend themselves well to verbalization. (Music is perhaps the outstanding example.)

Motion Pictures on the College Campus

Probably the major characteristics of motion-picture film which distinguish it from the other two media discussed in this chapter are its non-electronic nature and its non-instantaneous character. In education, motion-picture film is useful primarily as a medium for program production and storage. The film camera may be regarded as an observational instrument, but it is useful only in applications where an appreciable lapse of time between the event to be observed and its analysis is tolerable. Film may be considered a distribution medium in the sense that multiple prints are possible, but it is a far less efficient distribution medium than television or radio. Nevertheless, when motion pictures are seen by large audiences in a large geographical area, film deserves recognition as an important mass communications medium, even though the time involved in the distribution process is much greater than in the case of other mass media.

For purposes of this chapter, our interest in film is confined primarily to the production of film programs. (Once produced, films become audio-visual teaching or learning aids, suitable for use in classrooms, as reviewed in Chapter 8, or for use by individual students, as reviewed in Chapter 10.) Like television and audio programs, film programs normally require effort by a team of people utilizing specialized facilities in a studio environment. While films can be produced by kinescope photography of television images (as noted above), there are still many advantages in the use of direct photography for certain types of films. At the present state of the art, for example, it is somewhat more practical to produce film programs in color by direct photography than through television techniques, and many types of animation can be produced most efficiently by direct photography. Any college contemplating intensive use of both television and film can probably realize significant advantages by installing joint production facilities that permit the two media to supplement each other, rather than compete with each other.

Comments on the "State of the Art" in the Technology of Program Production and Recording

1. Audio Program Production. The equipment required to produce audio programs of high technical quality has become quite thoroughly refined as a result of the extensive experience accumulated by audio engineers in broadcasting, in the recording industry, and in the sound-recording branch of the motion-picture industry. Most of the "speech input" equipment required for typical audio programs can be obtained in convenient pre-assembled consoles or consolettes, available from a number of manufacturers. Such consoles also include inputs for such devices as turntables and tape recorders, and provide convenient mixing and monitoring facilities. For stereo applications, it is necessary to employ dual-channel equipment; the better stereo consoles

have arrangements permitting simultaneous control of the levels in the two channels. The level of technical skill required to operate audio equipment is not particularly great, but it is almost universal practice to relieve studio performers of any responsibility for operating equipment; this function is performed by an audio operator, normally seated at the control console in a glass-enclosed control booth outside the studio. A so-called "disc jockey", however, may be expected to serve both as an announcer (or performer) and as an operator. One of the most significant labor-saving devices now available for audio studios is the cartridge tape recorder, usually employing endless-loop tape cartridges with provision for automatic stopping and cueing. This equipment provides push-button access to pre-recorded material such as announcements, theme music, sound effects, and even complete programs; cartridge tape equipment greatly minimizes the need for an announcer to "stand by" in an announcer's booth for intermittent announcing "chores," and also minimizes the risk of human errors in the production of complex programs.

In summary, a college should have little difficulty in finding electronic equipment well matched to its requirements for audio program production. It is also necessary, however, to direct professional attention to the acoustic design of audio studios. Fortunately, the art of studio design has also been quite refined, and a great deal of reliable design information is now available through acoustic consultants and broadcast engineering handbooks.

2. Audio Recording. While a number of professional-quality disc recorders are still in service in broadcast stations and recording studios (Stephens College has one in its present radio studio plant), the magnetic tape recorder is now

used for the great majority of audio recording applications. Even in the manufacture of disc records for the home and school markets, the "master" recording is now commonly made on tape, and transfer to a master disc is accomplished under carefully controlled laboratory conditions. Because of the versatility of the tape recorder and the wide distribution of tape playback equipment, there appears to be little reason for a small college to make further investments in disc recording equipment. It is desirable, however, to employ broadcast-quality equipment for the production of original or "master" tape recordings, so as to allow maximum opportunities for subsequent duplication and playback operations without serious degradation of quality.

3. Audio Pickup for Television Programs.

For simple instructional television programs in which the voice of a professor serves as the primary audio source and it is appropriate for him to wear a lavalier microphone, the audio pickup problem is very simple; it is even reasonable to employ an automatic-gain-control amplifier in the microphone circuit to minimize the need for constant operator attention to audio level during the program. In the case of more complex television programs where microphones must be kept "off camera", however, the problem of developing satisfactory audio signals is considerably more difficult than in the case of radio programs. In addition to the use of at least one boom microphone, which normally require full-time attention by two operators (one to manipulate the boom itself, the other to "ride" the level of the audio signal from the control booth), a complex television program may require the use of a number of fixed microphones in concealed locations in the set. Each such microphone must be turned off and on at appropriate times, and realistic dialogue from two or more performers frequently requires the use of several "live" microphones at the same time with levels carefully adjusted to compensate for differences in voice levels and acoustic conditions. The acoustic environment in a television or film studio is normally quite unfavorable for the production of high-quality audio signals--enough so that the great majority of theatrical motion pictures utilize "dubbed in" sound tracks recorded in a totally different environment from that used for "shooting" the pictures. Because the separate recording of audio signals is not too practical for most television productions, it is common practice to make television studios as acoustically "dead" as possible (by liberal use of sound-absorbing materials in walls and ceilings) to minimize the background noise generated by air conditioners, camera blowers, and the movement of equipment, scenery, and the production personnel. In cases where the acoustic properties of a "live" room are required to achieve satisfactory audio quality for television programs, it is frequently necessary to resort to artificial reverberation in processing the audio signals.

4. Television Camera Tubes. Any American college planning the installation of a television studio quickly discovers that an early choice must be made between two basic types of television camera tubes, known as the vidicon and the image orthicon. These two types are sufficiently different that they cannot be used in the same camera equipment, and the "camera chains" (including the actual cameras on the studio floor plus the related control, monitoring, and the signal-processing equipment in the control room) form the very "heart" of the electronic system for a television studio. Vidicon equipment is used almost universally

for film pickup service throughout the American television industry, but there is no such unanimity in the choice of camera equipment for "live" pickup service. The image orthicon tube is almost overwhelmingly preferred by commercial broadcasters, but the vidicon is used quite successfully in a significant number of educational television studios. A complete analysis of the many important differences between vidicons and image orthicons is beyond the scope of this report, but the following brief summary may be helpful.

The image orthicon is a relatively large, complex tube (now available in two basic sizes and about a dozen different types), and it normally costs in the range of $1 to $2 per operating hour, depending upon the type selected and the technical quality standards of the person who decides when the useful life of the tube has ended. The vidicon, on the other hand, is a relatively small, simple tube (operating on photo-conductive principles) which costs only about 4¢ per operating hour. Because of the basic simplicity of the camera tube itself, a camera chain utilizing the vidicon costs only about half as much as equipment of comparable design quality utilizing the image orthicon. (Approximately $10,000 per camera chain for the vidicon, versus about $20,000 for the image orthicon.) The lower capital investment and the greatly reduced hourly cost for vidicon operation obviously make this tube very attractive to educational users. There are many significant differences in the technical characteristics of the pictures produced by the two types of tubes; in most direct comparisons, the image orthicon shows some advantages, but it is certainly possible to produce pictures that require no apology from vidicon cameras.

The continued popularity of the image orthicon among commercial broadcasters (and many experienced educational telecasters) results primarily from the superior operational flexibility of this more complex tube. In addition to very high intrinsic sensitivity (somewhat superior to the vidicon) the image orthicon has a unique gray-scale characteristic which is well suited to the practical operating conditions encountered in television studios. In contrast to the vidicon, in which the signal level follows rather faithfully all variations in the light level of the televised image, the image orthicon has a relatively distinct "knee" in its so-called "transfer characteristic." That is, the signal output from an image orthicon does not increase indefinitely as the light input is increased, but tends to "level off" at a certain light value. The net result is that an image orthicon tube behaves very much as if it had a built-in "automatic level setting" adjustment--the camera may be pointed at scenes in which light levels may vary over a range of several photographic "stops" (each "stop" representing a 2 to 1 change in light level), and will continue to deliver standard-level signals which look satisfactory (not necessarily ideal) at the output of the television system with virtually no attention from the video operator. Thanks to an "electron redistribution" effect at one of the active surfaces within the tube, the over-exposed areas in an image orthicon picture do not look "washed out", as they would in an over-exposed photographic film. While the picture highlights are prevented from exceeding a certain brightness level, the surrounding areas tend to become darker, preserving contrast in the highlight areas. In severe cases of over-exposure, image orthicon pictures may develop objectionable "black halos" around bright objects in the scene.

In the judgment of the RCA study team, the vidicon tube can be used successfully for instructional television programs, but its use involves operating handicaps relative to the use of the image orthicon tube (primarily in the requirements for greater care in lighting and more attention on the part of the video operator). To compete favorably with the image orthicon in terms of picture quality, the vidicon should be used in professional-quality equipment designed specifically for studio service. The low cost camera chains designed primarily for observational applications are not well suited to program production service, where high standards of picture quality and mechanical ruggedness are required. (observational cameras are normally mounted in relatively fixed locations, while studio cameras may be moved and handled almost continually).

5. Television Studios. While it is possible to produce instructional programs by simply moving television cameras into conventional classrooms, such programs normally fall far short of ideal utilization of television as an audio-visual communications medium. The lighting in ordinary classrooms is not well suited for television productions, and if television cameras are used simply to observe a professor teaching a normal class, it should not be too surprising that students viewing the class by television get the impression they are only spectators, not participants. A well-designed television studio provides the optimum environment for exploiting television as a true program production medium.

   The great majority of television studios now used in educational institutions or in ETV stations are patterned rather closely after those developed for commercial television broadcasting. While the production techniques developed for commercial broadcasting yield very satisfactory results in terms of final program quality, there is considerable room for further developments by "educational engineers" to improve the efficiency of instructional television studios. Some educators have been sufficiently concerned about the cost of manpower required to produce television programs by conventional broadcast techniques that they have developed special arrangements of studio equipment which permit a professor to exercise almost complete control of the technical equipment even while he is appearing "on camera." While this approach may represent almost the ultimate in production economy, it requires an unusually versatile and skilled professor to handle more than very simple presentations without obvious diversions of his attention from the subject matter of the program. A more promising approach, for which optimum "hardware" is yet to be developed, involves the use of a two-man team for the production of instructional television programs--a teacher or professor who concentrates on subject matter, and a producer-director who assumes primary responsibility (in close cooperation with the teacher, of course) for operating the equipment and producing a program which keeps the students' attention properly directed to the subject matter.

6. Television Display Equipment. A brief discussion of television display equipment is appropriate for this chapter on production and recording equipment because it is vital that people planning educational television production facilities keep firmly in mind the characteristics of the display devices on which television programs are to be seen.

Experience has shown that relatively conventional television receivers or monitors, employing picture tubes with diagonal measurements in the 21 to 23-inch range, can be used successfully in classrooms for groups of up to about 25 students. For larger groups, it is possible to employ either multiple receivers or large-screen displays using projection optics. (The latter devices may cost anywhere from 10 to 100 times as much as ordinary receivers, but often prove to be the most practical means for large-group television viewing in rooms seating 250 or more students.) Where receivers with conventional direct-view picture tubes are employed, it has become an accepted practice to employ a maximum viewing ratio of 12--that is, the most distant viewers may be located at a distance equal to 12 times the width of the picture. This viewing ratio is twice that normally accepted for educational films, and it thus becomes important that educational television programs intended for class viewing be planned with "legibility standards" somewhat different from those used in film production. As a general guide, the height of letters used in a television program should never be smaller than 4% of the picture height if it is important that all viewers be able to read them.

The great majority of television receivers now in use in classrooms are essentially adaptations of instruments designed primarily for use in the home, and do not necessarily have ideal characteristics for educational use. At its best, a television system utilizing the American 525-line scanning standards is capable of transmitting virtually all of the information that can be stored on conventional 16-mm film, but conventional receivers--mass-produced for the consumer market--normally fall far short of utilizing this full potential. Some of the compromises made in conventional receiver designs are based primarily on economic factors, while others recognize the general lack of knowledge and skill in electronics on the part of the general public. One characteristic of mass-produced receivers that should be of great concern to educational telecasters is the use of "overscan" to produce a picture that is appreciably larger than the visible area of the phosphor screen. The overscan technique is used primarily to minimize problems resulting from fluctuating power-line voltages in the home. It is not economically feasible to incorporate elaborate regulating or stabilizing circuits in receivers produced for the highly-competitive consumer market, but if the edges of the picture are hidden by the receiver mask, the average viewer is unaware of the degree to which picture size and centering may change as the line voltage changes. An unfortunate consequence of the overscan technique, however, is that program directors cannot count on anything displayed around the edges of the picture being seen by the home audience; the "safe area" is normally assumed to be the middle 80% of both the horizontal and vertical dimensions (or the middle 64% of the total image area). From an "educational engineering" point of view, the deliberate "throwing away" of 36% of the total picture area to accommodate a receiver stability problem that is readily solved by investing only a little more money in receiving equipment is very wasteful. ETV stations which direct a large fraction of their programs to home audiences have little choice but to conform to the "safe area" practices of commercial broadcasters (since there are millions of overscanned receivers in service), but the operators of closed-circuit systems, in which the cost of all receivers is normally a small investment compared to the cost of origination, recording, and distribution equipment, should give serious consideration to the use of receivers or monitors which have little or no overscan and which have sufficiently stable circuits to overcome the problems associated with fluctuating power-line voltages. If the distribution of motion-picture films is one of the functions intended for a closed-circuit television system, it becomes highly important that receiver overscan be minimized, since such film materials do not necessarily have the important details confined to the central "safe area."

The quality of audio reproduction should also be considered in the selection of classroom TV receivers, since the acoustic conditions in classrooms are far different from those in the home environment for which most receivers are designed. As a minimum, a classroom receiver should have a front-mounted speaker with at least five watts of audio power (10 watts would be better yet). Superior audio reproduction can normally be obtained by utilizing a separate sound system specifically designed for the classroom, not necessarily enclosed in the same cabinet as the receiver.

7. Television Tape Recording. Television tape recording has been refined to the point where it is now possible to obtain recordings which deliver television signals with almost negligible degradation relative to the original signals. (It is significant that

only signals are recorded on magnetic tape; there are no actual images on the tape, and no need for optical or electron-optical processes.) A television tape recorder is much more complex and expensive than an audio tape recorder because of the far greater information content of the television signal (which is normally accompanied, of course, by a high-quality program audio signal). To obtain the wide bandwidths required for video signals (typically 4 million cycles per second, compared to a maximum of 15 thousand cycles per second for audio signals), it is necessary to provide a high "writing speed" in a television tape recorder, and a high degree of mechanical precision is required to avoid visible "jitter" or other instability effects in the reproduced pictures.

Most of the television tape machines now in service employ 2-inch-wide magnetic tape which moves through the machines at either 7.5 or 15 inches per second, but the video information is recorded by small heads which pass rapidly across the width of the tape at a speed of about 1560 inches per second. (Four heads are mounted around the rim of a small, rapidly rotating wheel against which the moving tape is pushed by a curved guide). Each video track extending across the tape contains the information in about 16 lines of the television picture; it takes 32 tracks to record all the information in a single television frame or complete image. Narrow strips along the outer edges of the tape are used for the recording of audio information and a control track, which is needed to perform a function roughly comparable to that of the sprocket holes in motion-picture film. Standardization of television tape recordings of the transversetrack type has advanced to the point where recordings made on one machine may be played back on any other machine capable of operating at the same tape speed.

A relatively recent development in television tape recording is the "slant-track" recorder in which the high writing speed required for video recording is obtained by the use of either a single head or a pair of heads mounted on a rotating drum of relatively large diameter. The tape (usually, though not necessarily, of 2-inch width) is passed at an angle over this rotating drum in such a way that the video information is recorded along a track which extends diagonally across the tape, typically producing a single track from 12 to 26 inches long (depending upon the design of the particular machine) for each television field or vertical scan. Machines of this type are considerably simpler, and hence less expensive, than machines of the transverse-scan type, but they are not yet able to achieve the same performance standards with respect to picture stability. At the time of this writing, there has been insufficient field experience with slant-track machines to indicate clearly whether tapes will be freely interchangeable between machines, and there are, as yet, no common standards for machines made by several different manufacturers. Because of performance limitations, it appears unlikely that slant-track machines will ever replace the transverse-scan types for high quality program storage applications, but they may become very useful in education for observational and time-delay applications.

8. Television Film Recording. As an alternative to magnetic tape, motion-picture film may be used for the recording of television programs.

In principle, television film recording is accomplished simply by using a motion-picture camera to photograph the image displayed on a television picture tube, but there are many practical problems which must be solved simultaneously to permit high-quality recording by this process. One of the major problems results from the fact that television images are presented at the rate of 30 frames per second, while the standard frame rate for sound motion pictures is only 24 frames per second; to solve this problem, it becomes necessary to employ special photographic cameras and precisely-adjusted shutters. It is also significant that the output of a film recording system is essentially a "picture of a picture," and there is bound to be appreciable degradation of the image quality unless highly refined techniques are used both in the photography and in the display of the television image to be photographed. Degradation can also occur as a result of variations in the chemical processing of the film. For many years, the process of "kinescope recording" has had a rather poor reputation with respect to picture quality, but equipment now being developed is expected to refine the process to the degree that it will be able to compete favorably with tape recording. The capital investment required for this new equipment will be roughly comparable to that involved in a television tape recorder of the transverse-scan type, although the film recordings can be "played back" on conventional projectors which cost far less than tape playback machines. Already available is equipment capable of processing motion-picture film in as little as 90 seconds with good quality control, utilizing unskilled personnel.

For the small college, television film recording offers several significant advantages over tape recording, especially in the reduced capital investment in raw stock for the long-term storage of program materials (film stock still costs less than tape stock for a given amount of program time), and in the ability to "play back" television programs with either television film chains or conventional motion-picture projectors. In cases where it is desired to give individual students access to recorded television programs, the film approach becomes almost a necessity; even the cheapest television tape recorders represent investments more than 15 times greater than conventional sound film projectors.

9. Color Television. The usefulness of television in education can be greatly enhanced through the use of facilities capable of transmitting and displaying pictures in full color, especially in such subject areas as art, geography, and chemistry where color is relied upon to convey significant information. While color television equipment with very satisfactory performance characteristics is available today, the costs involved are so much higher than the costs of monochrome equipment that few educational institutions can justify the use of color until acceptance for the basic concept of instructional television has been built up to the degree necessary to assure very intensive use. At the present time, both color cameras and color receivers cost approximately three times as much as monochrome equipment of comparable quality. High-quality switching and distribution facilities are capable of handling either color or monochrome signals, and the cost of color accessories for television tape recorders

of the transverse-scan type increases their cost by only about 20%. (At the present time, there is little prospect that the low-cost slant-track recorders will be usable for color recording.) Relatively little work has been done to date on the development of commercial equipment for color television film recording, although interest is now building up in this area.

While color television has been authorized for broadcast use in the United States for almost ten years, public acceptance of the medium has only recently reached the point where manufacturers and broadcasters can expect to realize a profit from color operations. It is anticipated that the present level of commercial interest in the medium will stimulate new equipment designs during the next several years that may succeed in making color television much more attractive for educational use.

Specific Recommendations for the Stephens College Learning Center

As in the case of the audio-visual facilities reviewed in Chapter 8, Stephens College had made realistic provision in the Learning Center architectural plans for the installation of the facilities needed for the production of television, audio, and film programs even before the study reported here was initiated. The following summary, therefore, includes "endorsements" of certain plans developed by Stephens College and other consultants as well as suggestions originated by the study team. Technical details supporting the recommendations itemized below are presented in the specifications attached to this report as Appendix A, and cost estimates are presented in Chapter 13. Audio and video *distribution* facilities are reviewed in Chapter 10.

1. It is recommended that the two radio studios in the Learning Center be equipped with new broadcast-quality audio equipment suitable for the production of either monaural or stereo programs. A professional-quality audio tape recorder should be installed as a permanent part of each studio system.

2. To facilitate the production of audio programs where the reverberation characteristics of a small or medium-size auditorium are desired, it is recommended that the sound systems in the Assembly Hall and Cinema Laboratory be designed to permit the origination of either monaural or stereo programs from these areas under operating conditions comparable to those normally used in broadcast studios.

3. It is recommended that the film studio in the Learning Center be equipped with the existing equipment already in service elsewhere on the campus. This studio is needed both as a "laboratory" area for students enrolled in film courses and as a production facility for "single concept" films and complete instructional programs in situations where direct photography is required.

4. In recognition of the fact that Stephens College already owns a pair of broadcast-quality vidicon cameras in good condition, and in view of the fact that the television studios in the Learning Center are intended for use by students as "laboratories" for courses in the Radio-TV-Film Department, it is recommended that monochrome vidicon cameras be used exclusively for the initial installation. (In addition to their lower cost, vidicon cameras are less vulnerable to accidental damage by unskilled operators than image orthicon cameras.)

5. It is suggested that three additional

"live" cameras be purchased to provide a total of five cameras for use in the two television studios in the Learning Center. It is also suggested that an additional film chain be purchased to supplement the existing film chain, and that multiple remote control facilities be provided to permit operation of the television film equipment from either studio or the Master Control area. Electronic editing equipment should include facilities for split-screen displays and other special effects in addition to direct "cuts," lap dissolves, and superimpositions.

6. Because the television studios are to be used part of the time as "laboratory" facilities to prepare some students for potential careers in the broadcast industry, it is recommended that the installation of studio and control-room facilities be based on the conventional practices of the broadcast industry, with such modifications as may be required to accommodate groups of students in proper observing locations. It is further recommended, however, that student activities be confined to one of the two studios as much as possible, so that the other may be utilized by the professional staff of the Learning Center as an experimental facility to explore possible "high-efficiency" approaches to the production of instructional programs of the types most needed at Stephens.

7. It is recommended that provision be made in the Master Control room and in the conduit system for the future installation of camera cables to other areas in the Learning Center (notably the Assembly Hall) which might be used for some types of television program production.

8. It is recommended that work rooms for the production of graphic arts and photographic materials be installed in the vicinity of the television and

film studios, and that a professional art and photographic staff be developed to operate the facilities in these rooms as rapidly as demand develops.

9. It is recommended that television receivers utilizing picture tubes with 23" minimum diagonal be permanently installed in each classroom in the Learning Center, and that remote control facilities for these receivers be integrated into the audio-visual control systems reviewed in Chapter 8. It is suggested that provision be made in the Assembly Hall and Cinema Laboratory for the future installation of projection-type displays, to be acquired as soon as a need develops for large-group viewing opportunities. With respect to the overscan problem, it is suggested that the specifications permit not more than 5% loss of the picture area at each edge (specifying no overscan at all would be better yet, but would be quite unrealistic at the present "state of the art" unless the College is prepared to pay substantially higher prices for receivers). Sound reproduction should be accomplished through the basic sound systems needed for other purposes in each room. While the receivers should be permanently installed, the method of mounting should be such that it will be possible later to remove the monochrome receivers and substitute color receivers, which may involve cabinets of greater size; it is not recommended that the receivers be built directly into room walls with closely limited space.

10. It is recommended that provision be made in the Master Control area for the eventual installation of at least two television tape recorders and at least one television film recorder. The present"home-made" television film recorder developed at Stephens may be usable as a temporary expedient, but it is recommended that this facility

be replaced with professional-quality equipment as soon as economically feasible. (The new installation should include a rapid film processor.) It is suggested, however, that the highest priority be given to a television tape recorder of the transverse-scan type, since such a machine would give Stephens the capability of utilizing recorded materials from outside sources as well as the capability for local recording and playback. While the purchase of a second machine might be postponed for a year or two, it should be noted that the use of two television tape recorders offers several important advantages over a single machine, including: (a) the opportunity to make copies or "dubs," (b) opportunities for considerably more elaborate editing operations, (c) the opportunity to schedule both recording and playback operations simultaneously, (d) the opportunity to schedule lengthy recording or playback operations without time gaps for rewinding or reloading machines, (e) the opportunity to record or play back more than one signal at a time, and (f) considerably higher reliability (through redundancy) in the recording of important or never-to-be repeated programs. A tape machine can also be used effectively as a "back-up" for reliability protection in film recording operations.

11. It is recommended that the installation of color television facilities be delayed for at least two or three years, unless an urgent requirement develops sooner. It is suggested that the initial color installation to be made a few years hence consist of receiving equipment in a selected group of classrooms where color television materials are likely to be of greatest benefit, plus a color television film chain in the Master Control area. Live color camera equipment and additional color receivers could be added later.

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Chapter 10

THE STORAGE AND DISTRIBUTION OF INSTRUCTIONAL MATERIALS

The Role of Technology in Providing Access to Learning Resources

The learning resources which Stephens College desires to make readily available to its students include materials in a wide variety of forms, including books, periodicals, slides, filmstrips, films, disc recordings, and tape recordings. To be "readily available," the materials must be stored in convenient locations, they must be "indexed" in some fashion to permit a quick determination of the precise storage location of any specific item, and there must be convenient facilities to permit proper utilization of the materials. An important objective of the James M. Wood Learning Center project is to provide accessibility to audio-visual materials comparable to that provided for books and other printed materials by the traditional college library.

In contrast to books, most audio-visual materials can be utilized properly only with the aid of technological devices, and the level of use of such materials is bound to be influenced by the operating characteristics of these devices. Students and faculty members will probably never develop great enthusiasm for materials that can only be used with equipment that is difficult to set up and operate, so equipment for an effective "resources library" should, wherever possible, be permanently installed and designed for maximum ease of operation. At the same time, however, it is necessary to face up to the economic "facts of life" and keep both investments and operating expenses for the "resources library" in reasonable balance with educational benefits. As a general rule, audio-visual materials cost considerably more per item than do printed materials, and the equipment required to utilize audio-visual materials represent significant investments for relatively specialized functions. It thus becomes very important that true audio-visual "libraries" be designed for the highest possible efficiency in the use of both equipment and materials, consistent with educational objectives. Among the realistic approaches to efficiency are: (a) standardization of both media and equipment, (b) centralization of storage and use functions, and (c) maximum use of electronic distribution facilities.

Standardization for the Resources Library

At the time of this writing, it is impossible to predict exactly what effect new technological developments will have on the problems of storing and using learning resource materials. While it is conceivable that totally new methods of recording information may be developed (requiring additional types of equipment), it is also possible that much of the future technological effort may be in the direction of standardization, effectively reducing the variety of devices required to operate an effective Resources Library. For example, it would be technically feasible to adopt 16-millimeter film as an almost universal storage medium for two-dimensional information, using a single type of variable-speed projection mechanism to permit recovery of information in the form of motion pictures (with or without sound), still pictures, or printed text. The projection mechanism could be designed to have a "search speed" capability (fast forward and reverse), and relatively simple electronic or mechanical accessories could permit rapid reference to any predetermined frame number, or vary the sequence of presentation for programed instruction materials. Some such approach to standardization will undoubtedly be required as a first step toward the highly-automated library of the future. If strips or rolls of film containing two-dimensional material are mounted in highly standardized cartridge, for example, it becomes technically feasible to design large-scale mechanisms capable of performing on a remote-control, automatic basis the major functions of the "stacks" in a traditional library. Such mechanisms might be reminiscent of today's "juke boxes"; electrically-operated "arms" or "fingers" could respond to code numbers to select specific cartridges from storage slots, and place such cartridges on projection mechanisms coupled to special color television cameras, permitting students at distant locations to view, scan, or study material by remote control.

While speculation about future technological developments can be very stimulating, it is necessary to recognize present-day, practical realities in planning facilities for installation in the James M. Wood Learning Center. The RCA study team recommends that the following major media be utilized for the storage and use of materials in the Resources Library: books, periodicals, microfilm, 2 by 2-inch slides, 35-mm filmstrips, disc recordings, audio tape recordings, and 16-mm motion-picture film. Wherever possible, materials should be "processed" for storage in one of these forms, although there will always be a place for special collections in "non-standard" media, such as wall charts or microscope slides. Some of the media which may be used extensively elsewhere on the Stephens campus, such as 10 by 10-inch transparencies and video tapes, may be de-emphasized in the Resources Library, since they serve primarily as teaching aids for faculty or staff use, rather than as learning resources for student use. Transparencies of potential value to students could be transferred to slides (or series of slides, if overlays are involved) for storage and use in the Resources Library. Since video tape recordings require the use of relatively large, complex machines for playback, there is little point in separating the tape storage area from the machine area near the television studios. Where true "library" use of materials recorded on television tape is desired, it is always possible to transfer the materials to film at relatively nominal cost.

It is highly desirable that slides, audio tapes, and motion-picture films be mounted in standardized cartridges to minimize the risk of damage and to make the materials much easier to use. While a variety of cartridge designs are currently available for each of these three media, it is questionable whether any of the existing cartridges and the devices which utilize them are sufficiently well adapted to the requirements of education to justify near-future standardization. Thus, the long-term interests of Stephens College may best be served by tolerating for a limited period the inconveniences of handling conventional reels of tape or film and a variety of boxes or trays for slides, meanwhile encouraging the development of truly optimum cartridge and equipment designs.

Centralization and Resource Library Facilities

In the interests of efficiency and convenience, the great majority of the materials which Stephens College intends to make available to students should be stored and used in the Resources Library. In addition to the conventional reading tables, lounges, and study carrels designed for the comfort and convenience of students and faculty members in using printed media, the Resources Library should provide facilities for utilizing audio-visual materials.

The architectural plans for the Resources Library include six sound-conditioned listening rooms (nominally 8 feet square) for individual or small-group television viewing and for use of audio materials requiring loudspeaker reproduction for maximum effectiveness. These rooms should include facilities for stereophonic playback of both disc and tape recordings, and should have either built-in or "plug-in" facilities for the small-scale projection of both still pictures and motion pictures.

The listening rooms should be supplemented by a significant number of individual "study positions" specifically designed for utilization of one or more of the audio-visual media. One such facility already in use at Stephens is the "listening table"--a table with permanently-installed earphone jacks, signal selectors, and volume controls for eight individual student positions. It is recommended that the initial installation for the Learning Center include at least three such tables (24 positions) connected in such a manner as to give access either to the audio signals distributed through the campus-wide system (described below) or through a local system confined within the Resources Library.

Additional study positions should be provided in the form of semi-private carrels with facilities for individual use of visual materials (including television displays) as well as audio materials (through earphones). When cartridge-type facilities become developed for the majority of materials so that it becomes reasonable for students to handle them directly, many of the study carrels might be equipped with complete facilities for utilizing disc recordings, tapes, still pictures (including microfilm or the equivalent), and motion pictures. If equipment of suitably compact, "modular" design becomes available in the future, it may be possible to realize significant economies in the operation of the Resources Library through the use of "plug-in" projection or playback units which are "checked out" by students along with certain materials, then carried to the student's study position. Until such "optimized" equipment becomes available, however, it is recommended that Stephens College make available for use in the individual study carrels the most appropriate items in the current inventory of audio-visual aids which may be "released" from classroom teaching service as a result of the new facilities to be permanently installed in the Learning Center. Much of this equipment is not too well designed for unsupervised use by students, but with a little attention to convenient mounting arrangements and such minor adaptations as the installation of earphone jacks (where required) and the removal or disabling of unnecessary controls, the equipment can be used temporarily as the Resources Library itself is built up. It will undoubtedly be necessary to purchase modest quantities of some items, such as individual filmstrip viewers and microfilm readers.

To permit effective use of motion-picture film in the Resources Library in the immediate future before cartridge-type equipment becomes available, it is recommended that the need for student handling of film and projectors be minimized by installing a series of perhaps 6 or 8 rear-projection booths to form at least one wall of the room where films are stored. With such an arrangement, a student or faculty member desiring to see a film would submit the request to the film librarian, who would immediately assign the requestor to a specific booth, remove the film from its storage shelf, and thread it up on the projector corresponding to the assigned booth. The projector, although located physically in the film storage room, could be controlled remotely by the viewer in the booth; minimum controls should include forward, reverse, stop, and earphone sound volume (still-frame projection would be highly desirable). When the viewer is finished, the film librarian would remove and rewind the film, and return it to the proper storage location; no time-consuming inspection should be necessary, since the film is handled only by the trained librarian.

The number of individual study positions required in the Resources Library depends in large measure upon both the degree to which students are encouraged to use individual learning resources and the availability of facilities at alternative locations on the campus. For example, if individual dormitory rooms are equipped to receive both audio and video signals from a "master" distribution system, and if the majority of "assigned" audio-visual materials are placed on this system, the demands on listening or viewing facilities in the Resources Library could be significantly reduced. Because the library itself must necessarily develop relatively slowly, it should be possible to add facilities gradually as needs develop. Assuming that the enrollment at Stephens is permitted to "level off" in the vicinity of 2,000 students during the next several years, the study team estimates that approximately 100 individual study spaces for audio-visual materials may eventually be required in the Resources Library. For the initial installation, it is suggested that audio-visual facilities be provided for approximately 20 individual carrels in addition to the 24 "listening table" stations and the 8 motion-picture viewing booths suggested earlier.

It is by no means necessary or desirable to do away entirely with divisional or departmental libraries when the Learning Center is placed in operation. In general, materials which are designed primarily as teaching aids may properly be retained by individual faculty members or in departmental libraries, although in many cases it might be desirable to provide duplicate copies in the Resources Library for easy student reference. Likewise, highly specialized materials should be located where they are most likely to find effective use. It would be pointless, for example, to store in a distant building the materials intended for use primarily in the learning laboratories discussed in Chapter 11. To support use of the "House Plan" concept, it may be necessary to develop relatively small collections of learning resources in certain dormitory areas. It is highly desirable, however, that all resource materials be listed in the master card catalog (or equivalent index facility), and that the locations of all materials be fully identified on the catalog cards. Since Stephens College is a relatively small institution, it is unlikely that the total quantity of resource materials will become great enough within the next decade or so to justify or require the use of any highly-automated "information retrieval" facility to supersede the traditional card catalog file.

Electronic Distribution Facilities

Extensive closed-circuit distribution facilities for both video and audio signals should play a major role in making the resources of the Learning Center readily accessible to both faculty and students at Stephens. As a general rule, electronic transmission facilities provide a low-cost approach to the distribution of audio-visual materials needed at about the same time in more than one classroom or by more than one individual student. Within the James M. Wood Learning Center, electronic distribution facilities should provide connections from central storage and control areas to virtually every teaching and learning space throughout the Center. The closed-circuit systems should also be extended well beyond the Learning Center, providing signals to all existing classrooms on the Stephens campus, and eventually to all dormitory rooms as well. An FM broadcast station, capable of serving the entire community with cultural, informational, and instructional programs could also be regarded as a logical extension of the closed-circuit system. (A broadcast television station would be technically feasible, but it is questionable whether the expense of installing and operating such a station is justifiable for a college of the size of Stephens, especially in a community where there is already a television station operated by a major university.)

Since multiple-channel video distribution is essential to meet the objectives of the Learning Center, it is recommended that the video distribution system be of the so-called radio-frequency (rf) type, with coaxial cable as the primary transmission medium. Provision should be made for at least 12 video channels, although only five or six may be required when the Learning Center is first placed in operation. Provision should also be made for injecting television picture signals into the system at any outlet point for transmission back to the "master control" point, from whence they could then be distributed throughout the entire system via one of the regular channels. For practical reasons, an "inbound" television signal would probably have to be modulated upon a carrier for transmission through the coaxial cable, requiring the use of a small modulator unit at the point where the signal is injected into the system. In all cases, of course, provision should be made for the transmission of audio signals to accompany television picture signals through the same cables, and the transmission facilities should be of sufficiently high quality to permit the future transmission of color television signals. It is recommended that several audio pairs be installed in the same conduits as the coaxial cable for future use as special intercom circuits or for transmission of program audio signals from any classroom back to the Master Control area.

Detailed specifications for the recommended coaxial-cable distribution system for the Learning Center are presented in Appendix A.

Television signals distributed through the system should include both locally-generated signals and "off-the-air" signals from the two commercial broadcast stations in the Columbia area (Channels 8 and 13). There should be no need to assign specific channels in the distribution system to specific local sources, but at one time or another the signals distributed through the system might originate from: (a) either or both of the "live" television studios, (b) either or both of the proposed television tape recorders (in the playback mode), (c) one or more television film chains, or (d) observational television cameras located at any point on the Stephens campus. Television film chains located in the audio-visual storage area of the Resources Library could provide a convenient means for distributing information stored on slides, filmstrips, or motion-picture film to any point on campus. Channels in the distribution system not required for scheduled program service could be made available for "demand" service at the request of individual students or faculty members. While it is technically possible to develop automatic switching, storage, and playback devices to provide unattended "random access" to stored materials from any point in the distribution system, it will probably be much more economical for the foreseeable future to rely upon human operators reached by telephone or similar communication devices to assist in the selection and transmission of unscheduled materials drawn from large "libraries."

The major audio distribution system for the Learning Center might be any of three basic types, depending upon cost factors and the availability of key components at the time the installation is made. One basic approach involves the use of multiple audio channels, probably employing frequency modulation, transmitted within the same coaxial cables as the television signals discussed above. If this approach is used, signals could be recovered at any output point on the coaxial system by an electronic device roughly comparable to the FM tuners conventionally used in high-fidelity systems for the home; a slide-rule dial (or any equivalent tuning means) could be used to select the one signal desired from the many which may be present in the cable circuit. The second basic approach involves the use of a separate audio pair between every potential use point and the "master control" point for the distribution system. If this approach is used, the levels used for distribution through the lines could be made adequate to drive earphones directly at each use point, but a relatively complex dial switching system (or the equivalent) would be required to permit the user to select the desired signal. A third approach involves the use of multiconductor cables in which all signals are present at all times (on separate pairs) and signal selection switches are located at each output point. Any of these systems could be designed to transmit stereophonic signals. In the case of systems based on the rf-carrier approach, a subcarrier technique, comparable to that used in FM stereo broadcasting, could be employed, while two separate pairs could be utilized in either of the direct-wire approaches.

The faculty and administration of Stephens College have indicated a need for a 24-channel audio distribution system in the initial Learning Center installation, and detailed specifications for such a system are presented in Appendix A. It is recommended that capability for expansion to meet future requirements be given appreciable weight in the evaluation of possible approaches. Signals made available for distribution through the audio distribution system might include:

(a) Language lessons, especially those most directly related to current class activities.

(b) Musical selections, including both "assignments" for music classes and programs for "background music" or general listening enjoyment.

(c) Speeches, discussions, or other audio materials, including both "listening assignments" made by faculty members for specific class groups, and materials judged to be of general interest. It might be desirable to use one or more channels during the evening to play back tape recordings of certain lectures delivered during the day; such recordings might be useful study aids for many students, especially those who may have been absent from the lecture hall or who may have had difficulty in taking notes.

(d) Local informational services, such as news, weather, and campus announcements. One channel might reasonably be devoted to an "audio index"--repetitive, tape-recorded announcements about the scheduled programs currently available on all other channels.

(e) "Off-the-air" signals from one or more commercial or educational broadcast stations (either FM or AM). The entire program schedules of some stations might be transmitted continuously through the system, or certain programs of special interest to Stephens students could be selected by means of high-quality radio receivers in the "master control" area.

(f) News broadcasts or other special-interest features received "off-the-air" by short wave from the major international broadcast centers. The schedule problems and propagation difficulties normally associated with international short-wave

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listening could be overcome, in large measure, by the use of tape recorders. It would be reasonable, for example, to arrange for an operator at the master control center to "tune in" once each day for English-language news broadcasts from major world capitals, and to record these broadcasts on tape for repetitive playback throughout the day on one or more of the audio distribution channels. (Such programs would not be intended, of course, to give students or faculty up-to-the-minute news, but could provide excellent insight as to how current events are interpreted by our friends and others overseas.) In cases where poor propagation conditions prevent good reception, a second attempt could be made an hour or two later, depending upon broadcast schedules.

(g) Student-prepared materials, both for entertainment and for serious learning purposes. It is reasonable, for example, to regard the preparation of audio programs as a desirable alternative or supplement to the traditional "term paper" as a means of providing learning opportunities. In some cases, small groups of students might be assigned to collaborate on the preparation of a dramatization of some historical incident, a "biography in sound," or an audio analysis of a specific problem. The audio distribution system could be used in the evening hours to give all Stephens students an opportunity to hear such "audio reports" by their classmates, and to give all students added motivation to utilize their voices as effectively as their pens or typewriters.

(h) "Demand" materials, drawn from the audio section of the Resources Library and transmitted on unscheduled channels (to the limit of their availability) upon the request of any student or faculty member.

To minimize the need for human operators, the great majority of the materials transmitted over the audio distribution system should probably originate from tape cartridge players, arranged to repeat automatically either on random time schedules determined by the lengths of the particular programs involved, or by automatic cueing devices that would initiate each "cycle" of all repetitive programs at pre-determined time intervals established by a master clock system. The latter approach, coupled with a daily program log or an "audio index" as described above, would permit a student to "tune in" at the beginning of a desired lesson or program with a minimum of wasted time. As in the case of the video distribution system, it would be technically possible to provide random access by remote control to a wide variety of materials to be transmitted on unscheduled channels, but it would probably be more economical to rely upon one or more human operators for this function.

The study team recommends that the "master control" point for the audio and video distribution systems be located in the Science-TV-AV-Film Building in the same master control area which serves the two television studios. Here should be located the basic transmission equipment, the television film chains, television tape recorders, broadcast receiving equipment, and appropriate numbers of audio tape cartridge recorders and playback units. At least one operator should be on duty in the master control area during all hours when the system is in operation to load machines, check the operation of automatic devices, pick up domestic or international broadcasts on schedule, and revise circuit connections from time to time as may be required to meet distribution requirements. At least two video trunk lines and at least eight audio trunk lines should be brought into the master control area from the audio-visual section of the Resources Library, where future installations of television film chains coupled to slide, filmstrip, and motion-picture projectors and a variety of audio playback devices would permit Resources Library personnel to respond to requests for "demand" materials with maximum speed and convenience. Eight or ten trunk lines should also be installed between the master control area and the "learning laboratories" in Walter Hall where most of the language programs may be expected to originate.

If Stephens College acquires a license to operate an FM broadcast transmitter, the master control function for this broadcast operation could be performed in the same area which serves the closed-circuit distribution systems (thus making all of the program sources potentially available for broadcast purposes), but actual studio operations would logically be performed in the section of the Learning Center designed specifically for this purpose.

Physical Storage Conditions for Audio-Visual Materials

Any complete "systems" for utilizing audio-visual aids should include provision for the convenient storage of materials under favorable environmental conditions. There are relatively few technical problems involved in the storage of materials, since various manufacturers offer standard cabinets and racks designed for the storage of practically every type of instructional material, but specific planning is required to assure provision for adequate storage space in the optimum locations and to develop an effective system of cataloging and labeling. It is also desirable that storage spaces be air-conditioned, wherever feasible, to avoid extremes in temperature and humidity. A few guidelines concerning storage conditions for several of the most-commonly-used media are presented below.

1. Phonograph Records. While records are not seriously affected by normal variations in temperature or humidity, they should not be stored near excessive heat sources or left exposed to direct sunlight over long periods, since they tend to warp if the temperature exceeds about 120°F. All 33 1/3 and 78 rpm records should be stored vertically in their original containers or in suitable storage albums to avoid warping. They should never be piled flat, stored at an angle, or left on the supports of a changing mechanism. (Because of their light weight and raised centers, 45 rpm records may be stored flat without damage.) Records should be protected from lint and dust; their original containers normally provide adequate protection. If surface cleaning becomes necessary, records should be wiped in the direction of the grooves with a soft cloth which has been dipped in cold water and wrung as dry as possible. In severe cases, it may be desirable to wash the surface with a diluted solution of a soapless detergent at room temperature. All records should be handled from the edges and kept free of fingerprints, which can lead to dust accumulation and eventual distortion or destruction of the delicate grooves.

2. Films. Because films have an inherent tendency to warp and shrink, they should always be stored under conditions of controlled temperature and humidity. When stored under conditions which are excessively dry, films become brittle and break easily. Many new or "green" films tend to lose loops when first run through a projector. To avoid this nuisance to the

instructor, it is good practice to run new films through a projector several times before placing in circulation. Whether films should be rewound after use depends on whether or not they are to be inspected by the central "library" or lending source; if inspected after each use, they should not be rewound. Films mounted on metal reels and enclosed in metal cans may be stored either vertically or horizontally.

3. Overhead Transparencies. As in the case of films, transparencies should be stored in air-conditioned areas to avoid expansion and contraction of the base material. All transparencies should be stored horizontally. If stored vertically, they tend to buckle, resulting in distortion and out-of-focus projection. If overlays are involved, vertical storage can result in the hinges slipping downward, leading to registration problems.

4. Slides. The physical storage conditions for slides are not particularly severe, although obviously they should be protected from dust, from extremes of temperature and humidity, and from prolonged exposure to strong light (which has a bleaching effect on the dyes used in color films). The major problem in slide storage is that of providing convenient access for inspection and selection. In most instances, slides are stored and used as complete sets, and it may be appropriate for a college to utilize the trays or magazines employed for projection purposes for storage also. (The cost of such devices is seldom negligible, but many designs permit trouble-free use of low-cost cardboard mounts, resulting in a net cost per slide that is comparable to glass-mounted slides without trays or magazines.) Because the amount of information stored on individual slides is relatively small, and can usually be

reproduced readily in one of the printed media, it is questionable whether there is any need to provide access to individual slides for student use. In other words, the slides stored in the Resources Library for use by students could be in the form of complete sets (often accompanied by audio tape recordings), which students would not be allowed to "break up" or change in sequence, although they should obviously be able to "skip over" or ignore slides in which they have no interest. Slides intended for use by instructors, on the other hand, should be stored in such a way that it is convenient to gain access to individual slides, to rearrange existing sequences, and to build up new sequences for specific teaching assignments. Cataloging and indexing slides for this type of use can be a very complex problem and is probably best handled at the departmental level. To minimize the problem of keeping track of the physical location of slides on "active service," it is probably desirable to provide multiple copies of slides which are used frequently by several professors.

5. Audio and Television Tapes. To minimize physical changes in the base material magnetic tapes should be stored in air-conditioned areas. Under no circumstances should they be stored or handled near strong magnetic fields which can distort or erase the recorded information. Low-humidity storage may cause the plasticizing agents in cellulose-based tapes to evaporate, leaving the tape brittle. Excessive humidity in a storage area, on the other hand, may affect the "binder" material which holds the oxide particles in the coating, resulting in a tendency for the oxide to be pulled off, especially in high-speed television tape recorders. Tapes which have been adversely affected by storage under improper humidity conditions can normally be restored by leaving them exposed for about 24 hours to a proper storage

environment (temperature 60 to 80°F, relative humidity 40 to 60%). To minimize physical distortions during long storage periods, tapes should be wound uniformly but not too tightly; unusually valuable tapes to be placed in long-term storage can be placed in optimum condition by winding them at normal operating speed on the take-up spindle of a professional-quality tape transport. Both video and audio tapes should be stored vertically to avoid distortion of reels and to prevent the tape from "settling" against one flange of the reel. When audio tapes are stored for long periods of time, there is a tendency toward "print-through," which refers to a slight transfer of the magnetic track between adjacent layers of the tape. The "print-through" effect causes layer-to-layer crosstalk--a low-level signal corresponding to the information stored in an adjacent level can be detected in the background of the desired recording. To avoid the "print-through" effect, it is desirable to play valuable tapes every few months on professional-quality equipment; this action also serves to relieve strains and adhesions, keeping the tape in better physical condition.

Duplication of Materials

The effective operation of the Stephens College Learning Center will undoubtedly require the use of duplicate copies of many types of materials. The making of such duplicates introduces problems of a legal, technical, and economic nature.

Legal problems are particularly significant in the case of instructional materials which have been purchased or are on loan from outside sources. It is an all too common practice, conscious or unconscious, for educators and educational institutions to copy, reproduce, or transfer from one medium to another purchased or on-loan materials without giving any particular consideration to whether the material is covered by a copyright or whether there may be other property rights involved. It should be remembered that the great majority of purchased instructional materials, whether audio, visual, or verbal, involve copyrights and other property rights. In essence, this means they should not be duplicated or transferred without the written permission of the owners of these rights, who may be the manufacturer, artist, creator, selling agency, or some other entity or person. In view of this situation, it is recommended that no attempt be made to duplicate or transfer materials purchased or secured from outside sources unless written permission from the appropriate persons is first secured. If more than one copy is required, the additional copies should be purchased.

In situations where materials to be duplicated are produced locally, or where the College has clear reproduction rights, the problems are basically technical and economic. Some types of materials, such as transparencies and audio tape recordings, can be reproduced with essentially the same facilities used for production purposes, and the additional investments involved are so nominal that the advantages of local reproduction are easily realized. If a great deal of audio tape duplication is contemplated, the College should consider the purchase of a high-speed duplicator capable of making multiple copies with minimum deterioration of quality level. In the case of relatively complex processes, such as those involved in the reproduction of filmstrips and motion-picture films, it may be difficult to justify investments in reproduction equipment if good service can be obtained from outside suppliers. In the case of slides, multiple copies are easily made if requirements are anticipated at the time of original "shooting," but reproductions of existing slides are best handled by a well-equipped photographic laboratory.

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Chapter 11

PROGRAMED INSTRUCTION, TEACHING MACHINES, AND LEARNING LABORATORIES

The Role of Technology in Programed Instruction

The place of programed instruction and the so-called "teaching machine" in the small college is yet to be determined. The ardent early advocates of programed instruction who hailed this relatively new development as "the greatest advance since the invention of printing" have been subdued somewhat by encounters with economic and educational realities, but the "movement" appears to be here to stay, and will have important implications for the future of education. For purposes of this report, programed instruction is assumed to refer to recorded instructional materials designed in such a way that information is presented to the student a "frame" (or item) at a time, and the student is required to make some type of deliberate active or mental response to each frame before he proceeds to the next. In programs of the so-called "branching" type, the student's path through the instructional material is partly determined by his own responses. Again for purposes of this report, a teaching machine is defined as a device intended to implement the use of programed instructional materials.

Some of the advantages of programed instruction are almost self-evident: The student can normally proceed at his own pace; the requirement for frame-by-frame responses assures a high degree of involvement on the part of the student; interest is maintained and learning strengthened by the "reward" element, which may be nothing more than the satisfaction of knowing "answers" almost immediately. On the "debit" side, it should be noted that programs are quite expensive to produce and the cycle of production is relatively long. The art of writing programs is still not fully developed, and there are, as yet, few "standards" in either programs or teaching machines.

Programed instruction is not necessarily based on advanced technology; in fact, the great majority of programs now available are in book or pamphlet form, and require no machines for their effective use. Many so-called "teaching machines" (they might better be called "self-instructional aids"), especially the low-cost types, are in essence merely "mechanical page turners," and thus perform no real instructional function. In highly-sophisticated applications of programed instruction, however, where programs are supplied or controlled by electronic computers or where true audio-visual stimulation and/or responses are required, it is obviously necessary to employ some type of machine. Even in the case of relatively simple programs that could be presented in programed-text form, a well-designed machine offers potential advantages in eliminating the possibility of cheating and in automatically recording, timing, and analyzing the performance of students. Present disadvantages of the machine approach include relatively high cost and the lack of widely-recognized standards. Machine-type programs must be physically designed for a specific type of machine, and premature standardization on "hardware" could severely limit the development of the art of programing.

Because of the experimental status of the entire field of programed instruction, the study team does not recommend that extensive technological systems to support programed instruction be installed in the James M. Wood Learning Center prior to its opening. Stephens College is already actively engaged in research on programed instruction, and has sponsored the development of a number of specific programs (primarily in text form) to support specific teaching objectives. As this work continues, the requirements for "hardware" will gradually become clear, and modest "pilot" facilities can be installed to permit evaluation of new concepts before major investments are made. It is noteworthy, however, that the Learning Center as a whole, with its variety of learning resources and aids for teaching and learning, should provide an almost ideal environment within which to explore the potential role of programed instruction in the small college. Just as Stephens College has discovered the merits of using the various audio-visual media in combinations to supplement and reinforce each other, so it will probably discover that the techniques of programed instruction are of greatest value when developed in conjunction with other approaches to teaching and learning, rather than in isolation. The response recording systems and learning laboratory facilities discussed in subsequent sections of this chapter represent examples of technological systems which permit some of the benefits of programed instruction (notably the high degree of involvement on the part of the student) to be realized in a wide variety of learning situations.

Response Recording Systems

It was noted in Chapter 6 of this report that technological devices should prove useful in giving students opportunities to engage in educationally significant activities to reinforce learning, and in evaluating the needs and progress of individual students. During the past several years, a number of systems permitting students to make active responses (usually by pushing buttons) during either "live" or televised instruction have been developed and placed on the market; some of these systems have provision for recording student responses for later analysis. Several closely-related systems have also been developed to maintain effective "feedback" between students and teachers in situations where technological communication systems may prevent traditional "face to face" contact.

The RCA study team strongly encourages attempts to develop effective facilities in these areas, and urges Stephens College to participate actively in the development of a unified response recording system suitable for installation throughout the Learning Center. While each of the systems now available has certain merits, the study team feels that none of them is sufficiently refined or versatile to warrant immediate standardization. For maximum effectiveness, a response recording system should be "backed up" by data-processing facilities, and the investment in such facilities can be justified only if the level of use is great enough to show very direct educational benefits. In the judgment of the study team, realistic standardization of means of recording and analyzing responses should be given great weight in the development of programed instruction techniques for Stephens College, especially in the case of technically-advanced forms of programed instruction involving expensive audio-visual materials. The response recording system should not be confined to programed instruction, however; a well-designed system should also prove very useful in conjunction with conventional classroom instruction, televised instruction, and the administration of formal examinations.

Several different media, including paper cards, paper tape, and magnetic tape, are potentially useful for recording responses. While each medium offers certain advantages, the tentative recommendation of the study team is that Stephens College encourage the development of a system utilizing paper tape of sufficient width that it can be used for both "objective" responses (in the form of punch marks, which can be analyzed readily by machines) and "constructed" responses in the form of written words and phrases. Technological problems could be greatly minimized by the use of a system involving "objective" responses only, but the educational benefits would be seriously limited. Ordinary 3.5-inch adding machine tape may prove to be a very satisfactory recording medium. The chief advantages of paper tape over paper cards are the ease of storing a large quantity of "raw stock" in a small space without elaborate handling devices, and the ability to vary the physical length of the "record" to fit various program requirements. The major components of a system based on paper tape might consist of: (a) response recorder panels for students, (b) response indicator panels for instructors, and (c) response tape readers.

The response recorder panels could be designed for flush mounting in student desks or work spaces. Essential features of the response recorders, as visualized by the study team, should be: (a) means for storing a roll of paper tape and collecting the "used" tape as it emerges from the machine, (b) several pushbuttons arranged to actuate both tape punches and electrical switches, (c) means for exposing a short section of the tape to permit the writing of two or three lines of information directly on the tape, plus a transparent window which permits inspection but not alteration of a previously-written response, and (d) means for advancing the tape through the machine by either local or remote control. For greatest versatility, the response recorder should be designed as a "building block" suitable for integration into a wide variety of teaching or learning systems. It should be possible to use a response recorder panel to control such self-instructional devices as tape players, still picture projectors, and motion picture projectors. With relatively simple electronic coding devices actuated by non-audible tones, it should be possible to control an audio tape player in such a way that correct responses are needed to permit continued progress through an audio-visual program. The tape player could be arranged to stop automatically as each question is raised to test the student's comprehension, and "cocked" (through the electronic coding unit) so that only one button on the response panel can start it again; guesses or incorrect responses would be recorded on the response tape along with the correct response.

Response indicator panels coupled to the response recording system could make the system extremely helpful to teachers or professors. Such panels, intended for mounting at the normal teaching position, might consist of several meters plus facilities for assuming remote control of certain functions in all student response panels within a classroom. The meters might bear such labels as "TRUE, FALSE, and UNCERTAIN" or "YES, NO and DON'T KNOW," and could be calibrated in per cent so that operation of a particular button by all students simultaneously yields a 100% reading. Another meter labeled "SLOWER PLEASE" connected to corresponding buttons on the response recorder panels could provide an unobtrusive means for students to indicate to a professor that they are having difficulty in comprehending his material.

The response recording and indicating facilities described above could become a valuable aid to classroom teaching with relatively little change in traditional teaching techniques. A professor could, at any point in a lecture or discussion, pose a question and expect a response from every student. If the question is of the type that could be answered with an "objective" response (yes-no or true-false), the professor could learn immediately what proportion of the class has properly received his "message," and the recording tapes provide a permanent record of the response made by each individual student. Even students who do not know the answer could be expected to press the UNCERTAIN button. In the case of a question calling for a "constructed" response, the professor could pause for a moment while all students write the appropriate word or phrase on their response tapes, then press a "master advance" button that would move the tapes in all panels simultaneously so that the response just written is covered by a transparent window (to prevent further alteration). The professor could then discuss the correct response, and ask each student to indicate whether or not her response was correct. Upon pressing the appropriate buttons, the students would not only actuate the professor's response panel to give him the "feedback" he needs as to his teaching effectiveness, but would also "score" their own response tapes by adding a punch mark to permit later machine analysis.

Meaningful analysis of the mass of data resulting from the systematic use of a response recording system would probably require the use of at least two basic types of response tape readers. The tapes removed from the response recorder panels at the end of each class period or at the end of each school day could vary in length from a few inches to several feet, and would appear relatively unintelligible in "raw" form--collections of punch marks interspersed with cryptic words and phrases. Student names, subjects, dates, and other pertinent data for each section of tape could be recorded either in written form, by punched-in code numbers, or both. (If a system along the lines suggested here is eventually installed throughout the Learning Center, it will probably become "standard practice" for a student to write her name, date, and a subject or course number on the response tape when she first sits down at any "learning station," whether in a classroom, lecture hall, study carrel, or laboratory booth; to expedite automatic data processing, she might also be required to "punch in" related code numbers.) One basic type of response tape reader might consist of a "scanning" instrument which would permit a professor or a clerical assistant to review several tapes at once (probably side-by-side) to evaluate constructed responses in comparison with a "master" tape, and to make appropriate punch marks on the student tapes for later machine scoring. A second type of response tape reader might be highly automatic in operation, capable of comparing the punch marks on student tapes with data recorded by the professor on a "master" tape, and yielding data either in the form of simple totals or in more complex forms as may be required by the professor. Card-punching stations coupled to the response tape reader could produce summarized data for each student, each lesson, or each question within a lesson in a form suitable for use by conventional data-processing machines (the tapes themselves would probably not be saved, once the data contained on them is transferred to a format consistent with the requirements of the college's major data-processing facilities). Systematic use of response recording facilities would permit the development of highly detailed, automated records of the learning experiences to which each student has been exposed and her individual reactions to these experiences.

The type of response recording system suggested here for future installation in the Stephens College Learning Center would not only provide an extremely effective tool for guiding the growth and development of individual students, but would also provide opportunities for low cost educational research in a number of relatively unexplored areas. For example, proper analysis of response tapes would permit exploration of such factors as the significance of seat location within the classroom, and possible variations in the efficiency of learning throughout a class period. The sheer mass of data resulting from the use of a response recording system permits almost continuous monitoring of the learning process, overcoming in large measure the usual problems associated with small statistical samples and time lapses between learning experiences and measurements of those experiences.

Learning Laboratories

At least two rooms in the James M. Wood Learning Center are to be equipped as "learning laboratories," utilizing facilities and techniques that are now most commonly associated with language instruction, but which can be used to provide learning opportunities in a wide variety of subject areas. For purposes of this report, we may define a "learning laboratory" as an area where a significant number of students are normally engaged in related activities with provision for either group or individual audio-visual stimulation and for individual oral responses from each student as well as written or "objective" responses. In the learning laboratory, students would normally have access to a variety of instructional materials and to an instructor with basic competence in the subject matter under study. In addition, the instructor would normally have means for monitoring the performance of any student in the room. Very similar facilities for purely individual, unsupervised learning may be provided elsewhere in the Learning Center, notably in the Resources Library.

The basic facilities at each student position in a future learning laboratory might consist of a response recorder panel and an intercom panel connected to a headset and microphone. Through these facilities, the student could receive audio programs transmitted over wires from a nearby control center, and could make responses either through the microphone or the response recording panel. On an optional basis, some or all of the work spaces might be equipped with individual tape cartridge players and/or picture projectors with small, built-in screens, similar or identical to those provided for individual use in the Resources Library. Ideally, the tape cartridge players and picture display units should be designed as compatible, plug-in units which are automatically connected to the buttons on the response recorder panel and the intercom panel when mounted in place, and it should be possible to employ these audio-visual devices for programed instruction of either the linear or branching type. Some degree of acoustic isolation should be provided for each student's work space, especially if oral privacy is considered desirable in meeting learning objectives. Cushion-type earphones can be very helpful in minimizing extraneous sounds, but acoustic barriers may be needed to minimize psychological inhibitions resulting from attempts to pronounce unfamiliar sounds in the presence of classmates, some of whom may not be wearing earphones.

The "operations center" for each learning laboratory might consist of a teacher's console containing tape cartridge players for "master" tapes, one or more intercom control panels permitting private conversations with individual students, and monitoring facilities to check the activity taking place at any of the individual work spaces. The architectural plans for the Stephens College Learning Center provide a single "control room" with large observation windows located between two learning laboratories, permitting one instructor to monitor the activity in both laboratories simultaneously during "routine" periods, and permitting two or more instructors to guide the activities within a single room when necessary. This control room should be interconnected with the audio distribution system discussed in Chapter 10, so that some of the same program sources used within the laboratory area can also serve the campus-wide system.

Because truly optimum facilities for broad-use learning laboratories are not yet available, Stephens College intends to install relatively conventional "language laboratory" equipment in the two rooms designated for laboratory use in the Learning Center. Under the circumstances, the study team endorses this plan, and has included specifications for such conventional facilities in Appendix A. It may be noted that one of the two laboratories is to be equipped with listen-respond facilities only, which do not require a major investment. This room will provide an excellent site for "pilot" installations of improved learning laboratory facilities and prototype response recording facilities as they become available. The study team also recommends that consideration be given to the early installation of classroom teaching aids similar to those described in Chapter 8 to permit the learning laboratories to be used at least some of the time for group instruction. Since the control room is acoustically isolated from the learning laboratories themselves, provision should be made for an alternative teaching position at the front of each room. Specialized devices may be needed to link some of the audio-visual equipment used for group stimulation to the response equipment in the individual student positions. If Stephens College eventually develops a significant "library" of programed materials in audio-visual form, it will probably become desirable to convert additional spaces in the Learning Center for "learning laboratory" service.

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Chapter 12

DATA-PROCESSING FACILITIES

The Potential Roles of Data-Processing Facilities on the College Campus

Among the technological facilities deserving serious consideration by anyone planning a modern college plant are those related to data-processing. In this particular study of educational technology, primary emphasis was placed on communication facilities, but a limited review was also made of the present and future applications of data-processing equipment on the Stephens campus.

A small college like Stephens may have no individual data-processing problems which are of sufficient magnitude to justify a major investment in a high-speed computer and other electronic equipment, but the combination of all data-processing tasks, large and small, may support the acquisition of a modest data-processing facility that can remove significant paperwork burdens from faculty and staff members. Such tasks may be found in both administrative and academic areas. Comments on several potential applications for data-processing facilities are presented in this brief chapter.

Administrative Applications

Stephens College currently uses a variety of "business machines," mostly of the punched-card type, to perform a number of administrative chores, and is also giving serious consideration to further centralization and machine handling of additional administrative and bookkeeping functions that are now "diffused" throughout the campus. Among the administrative functions that lend themselves to machine handling are: (a) the keeping of student records, including grade reports, (b) the compilation and "posting" of examination scores, (c) daily attendance records, (d) payroll and other accounting data, (e) the development of class schedules and room assignments, (f) control of inventories of instructional materials, office supplies, and dormitory supplies, (g) maintenance of alumni records, (h) development of statistical summaries. It should be noted that the technological requirements for these various applications may vary widely, and relatively few of them require a sophisticated computer. Since a specialized machine "program" must be prepared for each task, it is generally appropriate to consider carefully the time and expense involved in preparing such a program and the specialized forms required to support it before a decision is made to use machine methods for any specific function.

Recording and Analysis of Student Responses

When and if Stephens College installs a large-scale response recording system along the lines suggested in Chapter 11, a significant volume of data-processing activity, probably on a daily basis, will be required to realize maximum benefit from the system. In a very real sense, a "universal" response recording system installed throughout the Learning Center will make it possible for professors and faculty advisers to evaluate the progress of students day-by-day without having to rely primarily on formal examinations administered only a few times per semester. The sheer volume of data flowing in from 1750 or more students would "drown" the system, however, unless machine methods are employed to process the data and reduce it promptly to meaningful summaries, which should be properly "posted" in the records for individual students or specific classes. The useful data abstracted from student response records might include: (a) the specific learning resources utilized by the student (including classes attended), (b) the sequence of learning experiences to which the student has been exposed, (c) the proportion of correct responses in each subject area, and (d) the time required by the student to "work through" certain types of programed-instruction materials. The same records could, of course, include data based on the subjective judgment of professors and advisers as submitted through the "individualized progress reports" currently used at Stephens. For a college the size of Stephens, it is unlikely that the data-processing tasks associated with the analysis of student response records would exceed the capabilities of relatively conventional card-handling equipment, although specialized input devices may be required to handle the original response records, as described in Chapter 11. The same response-recording and data-processing facilities could also be used for formal examinations and for various types of educational research.

Computer-Controlled Instruction

A few educational "pioneers" are giving serious attention to the possibility of using modern digital computers to control the flow of instructional materials to individual students through almost continuous evaluation of their performance. In such applications, data-processing facilities are used not only to analyze student responses (as outlined above), but also to suggest directly to the student what he should do next. In the judgment of the study team, such highly-automated approaches to education will have no significant application to Stephens College for at least the next decade. The current experiments in computer-controlled instruction should yield extremely useful information about the teaching-learning process, but the engineering members of the study team doubt that cost factors can ever be reduced to the point where the use of computers can be justified for more than very specialized teaching tasks. Considering both the cost of the computer itself and the cost of an input-output device (usually an electric typewriter), a facility for computer-controlled instruction is almost certain to involve investments of at least several thousands of dollars per student.

The problems of preparing programs for "instructional" computers are probably even more serious than the equipment cost factors. In spite of the popular conception of computers as "electronic brains," such machines are definitely not capable of independent "thought"; computers are capable only of performing basic arithmetic and logic operations, which can be handled with great speed and accuracy. When used to control an instructional process, a computer might be expected to accept a response (or a series of responses) from a student, compare this response against a wide variety of possible responses previously stored in its "memory," and select, on the basis of this comparison (and possibly several previous comparisons stored in its temporary or "scratch pad" memory), the next item of instructional material that most probably fits the needs of the student. Before the computer is able to guide the instruction of a single student, however, it must be supplied with an elaborate "program," which would normally require extensive labor by at least one professor and a computer programing specialist. This programing team would not only have to process the actual instructional material to put it in a form suitable for storage in the computer memory (or, alternatively, store in the computer memory the information needed to direct the student to specific instructional materials stored in the Resources Library or elsewhere), but would also have to anticipate all possible responses that might be made by the student following each question presented by the computer, and give the computer complete instructions as to "what to do next" if the student response matches any of the pre-conceived responses. The labor involved in preparing such detailed "programs" is several times greater than that involved in conventional teaching of the same subject matter, and there is no small danger that much of the subject matter may become obsolete before the program is complete. Even with the most carefully thought out computer program, it will probably remain necessary to keep "see your professor" as a major alternative when the student's responses fail to match any of the anticipated patterns.

Information Storage and Retrieval

Another application of data-processing facilities currently in the experimental stage is that of information storage and retrieval. It is conceivable that electronic data-processing equipment may eventually handle many of the functions of the traditional library, including the actual storage of verbal material (probably on magnetic tape) and the index function that is now most commonly handled through a card catalog. Such "automated" library techniques appear particularly attractive for large university or regional libraries where the sheer numbers of books, journals, and other materials are pressing conventional handling, storage, and indexing techniques close to their practical limits. In the case of a relatively small college like Stephens, however, it is questionable whether the problems in information storage and retrieval are likely to grow enough in the foreseeable future to justify any significant investment in technological facilities. The space required in the Learning Center for the storage and use of instructional materials in conventional formats is still well within practical limits, and the College library staff indicates that maintenance of the conventional card catalog file has not yet become a serious problem.

In the judgment of the study team, the first application of data-processing facilities in the information storage and retrieval category that should be considered by Stephens College is a two-way data transmission link to any outside "automated" library that may eventually be developed within a reasonable distance of the Stephens campus. Such a link could make it possible for Stephens to increase significantly the learning resources available to its students at minimum expense. It is quite probable that within the next decade or two most of the major libraries throughout the United States will be linked by data-transmission facilities permitting wide access to materials stored in any single library. Smaller institutions which can make no significant contribution to the total quantity of stored resources may be able to gain access to the major libraries through relatively nominal investments in data transmission equipment.

Chapter 13

SUMMARY OF COST FACTORS AND PERSONNEL REQUIREMENTS

Estimates of Investments Required for Learning Center Facilities

No engineering study of educational technology can be considered complete unless some attention is directed to economic factors as well as technical factors. While the exact cost of most of the facilities proposed in this report for the Stephens College Learning Center cannot be determined until bids are received and the installations are actually complete, the study team has felt a strong obligation to estimate the cost of each proposed system as realistically as possible so as to provide reasonable assurance that costs are consistent with anticipated educational benefits. The results of these cost studies are summarized in this chapter.

Because a great deal of "custom" design work (of unpredictable cost) is required for most systems, and because equipment meeting the minimum specifications presented in Appendix A may vary in price more than 2 to 1 (depending upon additional design features and better-than-minimum performance characteristics that Stephens College may find to be in its best interests), no effort is made here to present the detailed calculations made to support these estimates. It is acknowledged that estimates for specific types of equipment may eventually prove to be in error by as much as 2 to 1, but the study team believes the overall figures are accurate within 15 to 20 per cent, and should prove useful as guidelines to other colleges contemplating major technological facilities. A deliberate effort has been made to keep the estimates on the conservative or pessimistic side.

1. Audio-Visual Teaching Aids. This estimate covers presentation facilities for use in 15 classrooms and four large-group teaching spaces, as described in Alternate G (in our modified specifications) of the appended specifications; sound systems for the large-group spaces are covered elsewhere. $48,000

2. Facilities for Production of Audio-Visual Materials. Roughly one-third of this amount would be required to equip a centralized graphic-arts and photographic workroom, another one-third is allocated to 10 sets of "decentralized" facilities located near departmental offices (as recommended in Chapter 8), and the remaining third covers portable audio tape recorders to be assigned to individual professors. $28,000

3. Sound Systems for Large-Group Spaces. The sound equipment recommended for permanent installation in the Assembly Hall, Cinema Laboratory, and Multi-Purpose Rooms is of broadcast quality, permitting these rooms to be used for audio program origination as well as large-group instruction. $15,700

4. Audio Studio Equipment. This estimate covers two "radio" studios fully equipped for the origination of stereo programs. $16,000

5. Television Studio Equipment. This estimate includes about $45,000 worth

of facilities already owned by Stephens College; the total amount is shown here for the guidance of other colleges which may be planning comparable facilities. For this amount, Stephens College could equip two complete television studios with a total of five professional-quality vidicon cameras, two film chains, electronic editing equipment including special effects, audio origination equipment, and minimum lighting equipment. **$137,000**

6. Television Recording Equipment. This estimate covers a broadcast-quality television tape recorder ($45,000), a television film recorder ($46,500), and a rapid processing unit for 16-mm film ($15,000). **$106,500**

7. Television Distribution System. In addition to the basic coaxial cable distribution networks, this estimate includes about 20 additional television receivers not covered elsewhere. **$16,000**

8. Audio Distribution System. This estimate is probably the most "uncertain" one in the entire list, since there are several different approaches to the audio distribution system, but the amount shown here should cover the initial installation required by Alternate F of the appended specifications. **$26,300**

9. Resources Library Equipment. This estimate covers facilities needed for individual or small-group use of audio-visual materials during the first few years of Resources

Library operation; most of the equipment involved is already owned by Stephens College, but this estimate is included for the guidance of other colleges.	$16,200
10. *Learning Laboratory Equipment*. This estimate includes one 30-position listen-respond language laboratory, one 30-position listen-respond-record language laboratory, and a 16-channel repetitive program source suitable for use both within the laboratories and in conjunction with the audio distribution system.	$27,500
GRAND TOTAL	$437,200

Interpretation of Economic Factors

Viewed out of context, the total investment in technological facilities estimated above may appear to be only a very large number of dollars. As an aid in determining whether an investment of this magnitude is justifiable or not, one must compare it with certain other economic factors associated with education in general and Stephens College in particular. It should be noted that the $437,200 investment assumed for this review includes at least $61,000 worth of equipment already owned by Stephens College, and that several of the expenditures could be delayed well beyond the opening date of the Learning Center. The major investment in television recording equipment, for example, could reasonably be postponed for a year or so until the staff has developed experience in utilizing the basic television production facilities. On the other hand, additional expenditures will undoubtedly become desirable as superior equipment designs are developed and as the Learning Center itself "matures."

According to the best information available to the study team, the total cost of the James M. Wood Learning Center, exclusive of technological facilities, will be approximately $3.6 million. If all the facilities included in the above estimate are installed, the total cost of the Learning Center will be increased to $4.04 million, with the technological equipment representing approximately 11% of the total investment. The intensive use of technological aids to education is still sufficiently unusual that it is unrealistic to cite any particular fraction of the total cost of an academic plant as a "normal" or "optimum" allowance for technological aids, but in the judgment of the study team the 11% figure indicated here is very reasonable. As the industrial revolution gradually spreads through the field of education (that is, as educators learn to accept the technological facilities which can help them to increase efficiency and effectiveness), the proportion of capital devoted to tools as opposed to buildings is bound to increase, just as it has in industry.

As a national average, the cost of constructing conventional academic buildings amounts to about $42,000 per classroom. (This figure includes the cost of related corridor space and conventional utilities, but does not include the cost of such facilities as libraries, laboratories, and faculty offices that are normally associated with college academic plants.) It is reasonable, therefore, to weigh the potential educational benefits of all the technological facilities described in this report against the benefits that might be derived from about 10 additional classrooms (with no special equipment) that might be built with the same funds.

Summary of Personnel Requirements

The major item of annual expense for operation of the technological facilities in the Learning Center will undoubtedly be the payroll expense for the staff personnel required to assure proper operation and utilization of the facilities. In the judgment of the study team, a full-time staff of approximately 30 people would be required to operate the full complement of facilities recommended for the Learning Center. While the college administration must, of course, assume responsibility for planning and establishing any new organization which may be required, the following summary of personnel requirements may be useful as a guideline. Suggested reporting relationships are shown by means of indentations.

1. Administrative Personnel

- Educational Facilities Director
  - Administrative Secretary
    - Receptionist/Stenographer
    - Scheduling Assistant
  - Audio-Visual Librarian
    - Assistant Audio-Visual Librarian

2. Technical Personnel

- Chief Engineer (Reports to Educational Facilities Director)
  - Secretary
  - 6 Audio-Visual Operators (Ideally, these technicians should be trained to handle any operating position in the audio studios, television studios, or master control room, including television film and recording equipment.)
  - Audio-Visual Library Technician
  - 2 Maintenance Technicians (These maintenance specialists should have somewhat

more training and experience than the operating personnel.)

3. Production Personnel

Production Manager/Studio Director (Reports to Educational Facilities Director)
    Secretary
    Floor Manager/Lighting Director
    2 Staff Cameramen (Trained to work with either television or motion-picture cameras)

Art and Photographic Director (Reports to Educational Facilities Director)
    Secretary
    3 Staff Artists
    3 Staff Photographers (Trained as photographic technicians also)

It must be emphasized that an organization of the scope outlined above will be required only when the Learning Center is in full-scale operation; the staff may be built up gradually after the Learning Center is opened. There would be little point, for example, in hiring the "resident" production staff for the radio/TV studios until enough faculty members have developed an interest in preparing recorded instructional programs to justify such a full-time staff. The suggested organization does not include any personnel who would normally be considered members of the teaching faculty, but does include several people who are already employees of Stephens College, primarily in the field of Audio-Visual Services. It might well be desirable to integrate into the Educational Facilities Staff other existing service functions not shown here.

Although the study team does not have detailed knowledge of the salary structure of Stephens College, it is estimated that additions to the present staff required to operate the new technological facilities in the Learning Center will add approximately $120,000 to the annual payroll expense, and other expenses involved in operating the Learning Center facilities (including materials, renewal parts, etc.) may amount to something like $50,000 per year. While these expenses may require increases in the total instructional budget, a proper question to explore in efforts to justify such expenses is whether comparable educational benefits can be obtained at less expense in any other way. Simply hiring more professors or adding more books to the library does not make available to Stephens students the wide variety of learning experiences that can be offered only through the use of technological facilities.

Chapter 14

GUIDELINES FOR THE PLANNING AND PROCUREMENT OF EDUCATIONAL FACILITIES

The Determination of Equipment Requirements

It is no simple matter to establish the requirements for electronic, mechanical, or optical tools to be installed in an educational plant like the Stephens College Learning Center. Obviously, little progress can be made in educational effectiveness if new buildings are simply equipped with "carbon copies" of equipment already owned. On the other hand, hasty adoption of "new" and "different" facilities will not necessarily prove beneficial in reaching educational objectives.

An excellent start on the establishment of requirements for equipment in the James M. Wood Learning Center was made through a systematic survey of Stephens faculty members, conducted in March, 1962, during which each department head and major course instructor involved in the Learning Center project was asked to prepare a clear statement of both the educational objectives of his department or course, and the facilities he considers necessary or desirable to implement these objectives. This survey, the results of which were made available to the RCA study team, indicates that the great majority of the audio-visual devices and techniques already developed are used rather intensively at Stephens, as are new devices in trial stages. It is apparent, even to an outside observer, that sustained efforts and achievements have been made at Stephens to keep educational methods up to date.

Stephens College planned the faculty survey as a preliminary step in a complete study which was to include a thorough technological analysis. Both the College and the RCA study team recognize that many professors and department heads may not be aware of either the existence or the potential benefits of devices or systems with which they have had no experience.

In most institutions, the expressed needs of faculty members may be accepted as minimum requirements, subject more often to supplementation than to contradiction. Worthwhile suggestions for still more effective facilities may be obtained from both audio-visual and subject-matter specialists within the faculty, from outside consultants, and from the representatives of reputable equipment manufacturers. It is wise, however, to encourage professional study by faculty members of suggestions offered by outsiders before a commitment is made to them; it is hardly sensible to make major investments in facilities that will not be used efficiently after they are installed.

The Scheduling of Planning Efforts

The specific study project reported here was not initiated until the major architectural planning for the James M. Wood Learning Center was already completed. Thanks to the foresight of the faculty and staff of Stephens College, this study has not disclosed any significant areas where the opportunity to employ electronic aids has been seriously hampered by a "frozen" architectural design. As noted earlier, Stephens anticipated the use of electronic systems, and has made extensive use of outside consultants from the very inception of the Learning Center project. The architectural plans, therefore, reflect the guidance of many people skilled in the application of modern educational technology.

It is strongly recommended that other colleges which plan to use electronic systems as an integral part of new building and facilities, call in technological consultants and begin equipment planning at least as soon as architectural plans are started. Decisions to make optimum use of electronic systems can have major effects on building and room designs, fenestration, lighting, acoustics, seating arrangements, and many other elements of the learning environment. Maximum effectiveness is best achieved when electronic aids and systems are considered equal in importance to space design, climate control, and other architectural factors in the attainment of educational objectives.

The Role of Consultants

The decision as to whether a college should hire an electronics consultant when planning new or additional facilities depends upon several factors, including (a) the complexity of the system being planned, (b) the availability of competent personnel within the college itself, and (c) the amount of money budgeted for the planned project, both for its planning and its execution. The following comments about consultants in several categories may be helpful to colleges with little prior experience in the planning of major technological systems.

1. Independent Engineering Consultants or Companies. Many individual professional engineers and firms, located throughout the country, are in the consulting engineering business. Since most of these individuals and firms specialize in relatively narrow fields, care should be exercised in the selection of consultants in this category to make sure that the person or firm selected has had the type of experience required. A consultant

who has specialized in the acoustic treatment of auditoriums, for example, may not be at all qualified to review the plans for a language laboratory or to design a television studio. In the field of television and radio broadcasting, many consulting firms specialize in the area of transmission; a college contemplating a closed-circuit television facility should establish to its own satisfaction that a consulting firm has competence in studio design and closed-circuit transmission before making a firm commitment.

2. Sales Engineers of Manufacturers. Nearly all companies manufacturing radio and television equipment sell their products directly through their own salesmen. Many of these sales representatives are engineers with specialized training in the application of their companies' products in educational or commercial systems. The typical broadcast equipment salesman has had wide experience in the layout and installation of both television and radio systems, and can offer a great deal of valuable guidance and assistance. It must be acknowledged, of course, that a sales representative has a vested interest in his customer's decisions, but the representatives of established companies with good reputations for continuous service in the broadcasting or closed-circuit equipment business understand that their own best interests (and those of their companies) are served by giving customers sound advice. A desirable safeguard, of course, is to solicit guidance from the representatives of more than one company.

   While sales engineers are generally available to assist with the planning of relatively conventional ETV or radio installations at no cost to the customer, they are usually not in a position to design unusual or highly specialized systems which require extensive systems engineering. In such cases, manufacturing companies are frequently happy to supply the required systems engineering at a modest cost, or the company will assist its potential customer in making the necessary arrangements with a competent, independent consulting engineer.

3. Broadcast Station Engineers. Many colleges are able to obtain consultation services of significant value from the engineering staff of a nearby commercial or educational TV station. It is best, in such situations, to deal directly with the station's Chief Engineer or a supervisor high enough in the administrative structure to have a good understanding of economic as well as technical matters. Most chief engineers have had extensive experience with both studio and transmission equipment, although many of them may be unfamiliar with much of the distribution equipment used in closed-circuit systems. If only a nominal amount of consultation service is required, the station management or the chief engineer himself may be happy to render it at no charge, but if any significant amount of actual planning work is involved, the question of compensation should be carefully reviewed in advance.

4. Personnel from the College Staff. If the college already operates a broadcast station or a closed-circuit television system under the technical guidance of a competent chief engineer, he may be fully capable of serving as the "consultant" for new or expanded systems. If no such person is available on the college staff, and it is planned to install systems of such complexity that a chief engineer will be required in the future, it

is highly desirable to assign a high priority to the recruiting and hiring of a competent chief engineer so that he may be added to the staff while the facilities are still in the planning stage. The type of "vested interest" a chief engineer has in planning facilities for which he will be responsible for a number of years provides strong motivation for doing the best possible job.

In colleges which operate engineering schools, particularly in electrical engineering, it may be possible to obtain valuable consultation service from one or more faculty members. It must be noted, however, that the planning of large-scale communications system is a rather specialized branch of engineering; a professor with good or even outstanding competence in the engineering profession as a whole may be poorly qualified to plan a system utilizing equipment with which he has had no experience.

5. Suggested Guidelines as to the Need for Consultants. The administration of a college must decide for itself, of course, whether or not it wishes to hire a consultant to assist in the planning of technological facilities. The following generalized guidelines are based on the experience and professional judgment of the RCA study team.

   (a) If the purchases contemplated are what might be termed "packaged" audio-visual aids or materials, there should be no need for a consultant. The college usually has experience of its own as a guide to such purchases, or can readily obtain guidance from neighboring institutions of higher learning. In addition, audio-visual dealers in the area can be most helpful in recommending and demonstrating individual items of audio-visual equipment or materials.

(b) Where the project involves an investment of $50,000 or less, there is generally no need for an independent consultant unless the college has reason to believe that there is something highly unusual or specialized about its system. Most sales engineers are well experienced in the planning of such smaller systems. In the case of such systems as Language Laboratories, the distributor is normally competent to handle details of layout and installation unless the system desired represents a significant extension of normal capabilities. A major audio distribution system should be obtained through an Engineered Sound Distributor who has at least one professional engineer on his staff.

(c) Where a major communications system is planned, representing a capital investment substantially in excess of $50,000, a college is urged to give serious consideration to the possibility of engaging an independent consultant with appropriate experience. In general, the larger, more complex, or more specialized the system contemplated, the greater is the need for consultation service. Even a large, expensive facility such as a major television studio may not require the services of a consultant if it is based on widely-accepted design practices and the equipment is provided by a manufacturer in whom the college has complete confidence.

The Significance of Specifications and Competitive Bidding

The great majority of colleges supported by state or local governments are required by law to employ the process of competitive bidding for virtually all significant purchases, including technological aids to education. While a private institution may have no obligation to employ competitive bidding, it may elect to do so in its own best interests. To appreciate the merits and limitations of competitive bidding, one should consider its application to three rather different situations:

1. In the case of architectural or civil engineering projects, one normally retains an architect or civil engineer who draws up plans and specifications which describe completely what is to be constructed. The process of competitive bidding then helps to locate the contractor who can build the desired structure at the lowest cost. The structure itself will presumably be exactly the same no matter who builds it, provided one deals only with contractors of proven integrity.

2. In the case of manufactured products sold through multiple channels of distribution, competitive bidding helps an institution obtain the most favorable price for exactly the same products or for clearly equivalent products.

3. In the case of communication systems (such as closed-circuit television systems), the situation is quite different from either of the two above cases. There is normally only one channel through which one may purchase the products of any specific manufacturer, so competitive bidding is unlikely to reveal different prices for identical items. Although an institution may have unique requirements that call for a custom-designed system, the user does not normally have the opportunity to influence significantly the design of the basic components of the system.

> Unless an institution has the financial resources to underwrite major engineering programs (and the patience to wait for them), it is normally limited to making a selection of the equipment already designed and offered by various manufacturers.

Competitive bidding is potentially useful as an aid in making a choice between several different manufacturers of communications equipment, but the nature of the system finally installed may be profoundly influenced by the manner in which specifications are prepared and bids are evaluated. If the specifications are carefully written to reflect minimum performance requirements, and the final selection is made on the basis of price alone, one is likely to obtain the system which exceeds the minimum requirements by the least amount. A manufacturer whose equipment substantially exceeds the minimum specifications or who offers desirable features not specifically required is normally disqualified almost automatically by the higher prices he must charge for his superior designs.

If an institution really wishes to evaluate the offerings of several manufacturers in terms of quality as well as price, the bid procedure should place an obligation on each manufacturer to both specify and certify the actual performance characteristics of his equipment, and to justify in terms of the user's needs or convenience the special, non-specified features which may have influenced his prices. The institution then has the basic data necessary to evaluate intelligently the relative merits of each proposal. Presumably all responses from reputable manufacturers would meet the minimum requirements (if they were clearly stated in the bid requests), but the institution may find that its best interests are served by awarding a contract to someone other than the low bidder if the equipment offered has superior characteristics which are clearly worth the differential in price.

Since the preparation of specifications normally represents the culmination of all the planning effort invested in a major technological system, the actual writing effort should be entrusted to someone with the necessary technical experience to assure that the institution's educational objectives will truly be met. Among other things, the specifications must reflect a realistic understanding of what is currently available from reputable manufacturers. Costs tend to rise rapidly when special features or modifications are required which lift equipment from the "stock" category into the "custom-built" category. Specifications for large-scale systems should generally require that all major equipment items be the products of a single manufacturer to assure properly "matched" designs. Efforts to obtain more favorable prices on individual items by purchasing them separately frequently result in serious technical and operational problems which become the user's complete responsibility.

The specification-writing task for a private college can often be simplified substantially by direct references by brand name to products which the college knows to be satisfactory from its own experience or from the advice of trusted consultants. Many government-sponsored institutions are restrained by law from issuing proprietary or restrictive specifications, however, so the specification writers for such institutions must develop skill in specifying actual performance requirements in non-proprietary terms. Several guide specifications of a non-proprietary nature prepared by the RCA study team for Stephens College are appended to this report. These documents may prove useful as general guides to other colleges preparing similar specifications.

Sources of Specifications

Generally speaking, there are no nationally accepted or "standard" specifications for most of the technological aids to education. A great deal of valuable information and a few potentially useful specifications may be obtained, however, from sources like those listed below.

1. General Services Administration, Federal Supply Service, National Buying Division, Washington 25, D. C. This group has established basic specifications on many individual items of audio-visual equipment purchased by Government Agencies. It should be noted, however, that many of the specifications reflect special requirements, which may not be applicable to educational situations. In many instances, the "standard," high-quality equipment of reputable manufacturers cannot be bid against these specifications without many exceptions.

2. National Institute of Governmental Purchasing, 1001 Connecticut Avenue, N. W., Washington 6, D. C. While this group has an extensive file of specifications in many areas, access to this file is open only to members. Once again, the specifications are designed with government usage and requirements in mind.

3. Purchase Guide for Programs in Science, Mathematics, and Modern Foreign Languages (Ginn and Company). This Guide was prepared by the Council of Chief State School officers with the assistance of Educational Facilities Laboratories, Inc. for use by state and school authorities in administering Title III of NDEA. It gives specifications for many items of audio-visual equipment, but the specifications are so broad and general that they represent only a minimum guide which

"should reduce sales of shoddy, uneconomical or inappropriate items and assist reputable manufacturers in making products of high quality that can be sold at reasonable prices." (Quoted from the Foreword to the Purchase Guide.)

4. NAB Engineering Handbook, prepared by the National Association of Broadcasters (A. Prose Walker, Editor-in-Chief), and published by the McGraw-Hill Book Company, New York, in 1960. While relatively expensive ($27.50), this handbook provides a great deal of useful data for anyone planning significant radio or television facilities. Section I, entitled "Rules, Regulations, and Standards," is particularly pertinent to the study reported here; in addition to a number of actual performance standards, this section of the NAB Engineering Handbook also describes standard methods of measuring many performance characteristics (as established by professional engineering societies) and lists many additional standards available from other sources. While the specifications that may be found in this handbook reflect the high performance standards required for broadcasting, many of them are directly applicable to the requirements of education. While some educators are inclined to view facilities of broadcast quality as too expensive or too "deluxe" for educational use, the engineering members of the RCA study team feel that there is no justification for the assumption that the performance requirements for communications facilities used in education are less severe than those for facilities used in advertising or home entertainment.

5. Trade Associations, such as the American Standards Association, 10 E. 40th Street, New York 6, N. Y.; Association of School Business

Officials, 1010 Church Street, Evanston, Illinois (This organization has issued an excellent publication, "Purchasing and Supply Management Manual for School Business Officials," which contains some fine sections devoted to standardization, quality, specifications, etc.); the National Association of Educational Buyers, 1461 Franklin Ave., Garden City, N. Y.; the Electronic Industries Association, 1721 DeSales Street, N. W., Washington 6, D. C.; and the National Audio-Visual Association, 1201 Spring Street, Fairfax, Virginia. While these trade organizations do not generally issue specifications on particular items of equipment, they can offer help and assistance in establishing guidelines for specifications.

6. Manufacturers' Catalogues. These can possibly be the best source for establishing performance specifications for A-V equipment. From an analysis of catalogue sheets of various manufacturers, basic specifications can be set up on which several sources of supply can bid.

Standardization

Any college planning major new educational facilities comparable to the Stephens College Learning Center should give serious study to the problem of standardization in two basic areas: (a) in the selection of basic types of equipment or media, and (b) in the selection of brands of equipment. The college which attempts to buy a few samples of every worthwhile product which appears on the market as a promising teaching or learning aid will soon discover that it owns many alternative tools for the same basic jobs, and will undoubtedly experience great difficulty in training both students and staff members in their proper use. While a poor or hastily-adopted standard can stifle new developments, intelligent standardization can play a major role in stimulating the growth of technology in almost any area, including education. The wide acceptance of a relatively few film sizes has had a very beneficial effect on the development of photography, and the radio and television industries owe much of their success to strictly enforced standardization with respect to the characteristics of radiated signals. By eliminating unnecessary duplication and assuring a high degree of interchangeability in the materials and equipment produced by various manufacturers, standardization becomes a major tool for holding down costs and assuring maximum effectiveness in the application of technology.

There are wide differences in the degree of standardization presently achieved in the various media associated with educational technology. Examples of materials which are well standardized are 2 x 2 slides, 35-mm filmstrips, and 16-mm films. These materials may be obtained from a great variety of sources and used on instruments provided by many manufacturers. Audio tape, on the other hand, is an example of a medium that is not yet well standardized. While the tape itself is almost universally 1/4" wide, there are at least four "standard" speeds, a wide range of track patterns (full width, half width, quarter width, etc.), several approaches to the placement of heads for stereo recordings, and several approaches to cartridge mechanisms. A college intending to build a major "library" of audio-visual materials is well advised to select the minimum number of media and standards within each medium as the basis for its library. Comments on the "state of the art" in the most important media which may be helpful in choosing local standards are presented in earlier sections of this report. Once the basic technological media have been selected, a college should consider standardizing on a single brand (or, at most, two brands) for each type of equipment. Such standardization can bring the following benefits:

(a) Instructors and students can become more familiar with the characteristics of the equipment, thus developing greater confidence and effectiveness in its use.
(b) Training problems for maintenance and service personnel are reduced, probably resulting in superior maintenance and operation.
(c) Investments in inventories of spare parts and accessories can be minimized.
(d) By specifying only a single brand, the college may be able to obtain a better quantity price and develop improved channels of communication with the equipment supplier or manufacturer.

Standardization by a college on a single brand of equipment should never be applied so rigidly as to rule out completely the purchase of competing brands. Overemphasis on standardization may lead to inflexibility and resistance to change, with resultant obsolescence and stagnation. When the quality of a brand that has been accepted as a local standard appears to be deteriorating or is beginning to present major service problems, or when there is some evidence that a competing manufacturer is producing a superior product in the same basic price range, a sample of the possibly superior product should be purchased for evaluation. If found definitely superior, the new brand should be specified in future purchases. If the superiority is only slight, however, it is usually preferable to continue to use the earlier product in order to retain the benefits of an established standard.

Evaluation of Equipment

Any institution which issues specifications implies that it has the ability to evaluate the merits of similar products by different manufacturers. Without this ability, the institution has no sound basis for preferring one product over another, or for determining whether either product meets the desired educational objectives.

The specifications for a major system should either include a suitable "proof of performance" test, or should require clear certification of the system by a licensed professional engineer. It is highly desirable that the key personnel concerned with the operation and maintenance of a major system be given an opportunity to check it thoroughly before it is formally accepted by the college.

An excellent guide for the evaluation of smaller purchases has been published by the School Facilities Council, 257 Fourth Avenue, Mount Vernon, New York under the title: "The Most Important Step in School Buying--Evaluate!" Among the factors suggested by this guide in a checklist for evaluating purchases are:

1. Meets school specifications.
2. Suitability of design and construction for educational use.
3. Capacity or quality beyond minimum requirements.
4. Special design and construction features that facilitate use or application.
5. Reasonable life expectancy.
6. Ease of maintenance.
7. Availability of replacement parts.

The cited publication contains many other good suggestions and guidelines for the purchase and evaluation of educational equipment.

While complete tests to prove whether or not equipment complies with detailed technical specifications may be beyond the capability of the small college, a number of relatively simple tests can be performed to provide useful data. In the case of any device intended to project a picture, for example, a projected test pattern can be used to check for resolving power; if the "line number" that can be resolved in the corners is less than about 70% of that in the center, the optical system is probably of poor design, and color fringes in the image also indicate poor optical quality. A simple light meter can be used to compare light levels in the center and corners of a projected image; variations should not exceed about 30%. In the case of slide projectors, such factors as blower noise, slide temperature, and tendencies for slides to jam or to pop out of focus can be checked subjectively without elaborate equipment. In the case of motion-picture projectors, very simple but effective performance tests can be made with the aid of test films available from the Society of Motion Picture and Television Engineers. It is also possible to obtain, at nominal expense, special test records and tapes to check the performance of audio reproduction equipment. One important characteristic of an audio tape recorder can be tested by recording a brief section of tape with no signal present, and then playing back the same tape with the playback level set high enough that a "hissing" sound is plainly apparent. The hiss should disappear when the recorder is stopped; if it does not, then the playback amplifier is contributing noise to the playback signal, and is either of inferior design or in need of maintenance. Uniformity of motion (absence of "wow and flutter") is another characteristic that distinguishes a good tape recorder from a poor one. One of the best subjective tests for the characteristic is the recording and playback of piano music; wavering of the tones indicates excessive variations in motion.

Guidelines for Equipment Replacement and Renewal

It is strongly recommended, as a matter of good business practice, that any college making a significant investment in technological aids adopt some systematic plan to amortize the cost of the major equipment and materials over time periods approximately equal to the useful life of the equipment or materials. By so doing, the college should be able to maintain the financial resources necessary to replace old or worn-out facilities without the necessity of seeking special appropriations or budgets each time a major item requires replacement.

There are few established norms as to the life expectancy of the various types of educational aids. A decision as to the amortization period is generally based on: (a) how often the equipment is used, (b) maintenance and service costs, (c) possible deterioration of quality and performance, and (d) the degree to which the equipment is likely to become obsolete by new technological advances. When the usage of an item of equipment is heavy, the "wear and tear" is obviously greater, resulting in the need for more frequent service and possible deterioration of quality. The situation is quite analogous to that concerning automobiles in various classes of service: with constant and hard usage, a taxicab may wear out within a year, whereas the same type of automobile in the hands of an average owner may give fine service for five years or more.

For colleges having insufficient experience with technological equipment to establish their own estimates of life expectancies, the following general guidelines may be helpful. The life expectancy of high quality audio-visual equipment with constantly moving parts (8 mm and 16 mm projectors, tape recorders, automatic slide projectors, record players), and in operation approximately 4-6 hours a day, is generally on the order of 5 to 7 years. Longer life can be achieved with good preventive maintenance by qualified technicians who know the equipment. Shorter life may be experienced when the equipment is operated by untrained persons and maintenance is neglected.

Where there are no, or very few, moving parts, as in the various types of manually-operated slide projectors, life expectancy may easily be 10 to 15 years or longer. A similar life expectancy can be generally realized for audio system components (amplifiers, speakers, high-quality microphones, etc.), assuming regularly scheduled check-up and maintenance. Permanently-installed television studio and distribution facilities generally have a life expectancy in the vicinity of 10 years, assuming proper maintenance and renewal of expendable components.

In this age of swift-moving technological advances, there is a constant threat that equipment may become obsolete before the end of its normal life expectancy. New methods, better materials, improved circuits, all can contribute to more effective, more durable, or lower cost products. Although future developments cannot be pin-pointed in time, their possibility should at least be given weight when establishing amortization plans and schedules. It should be recognized, however, that the word obsolete is by no means synonymous with useless. Persons unfamiliar with technology often express an unwarranted fear of obsolescence, apparently assuming that obsolete equipment is no longer useful. As long as one deals only with well-established, reputable manufacturers who do not prematurely abandon spare parts service and other forms of support for their products, an investment in a technological device or system is not significantly affected by the appearance of an improved device or system on the market. If the investment was originally justifiable, there is no reason why it should not remain so throughout the originally-anticipated life span of the equipment. The availability of superior or lower-cost equipment simply means that it may become justifiable to obtain replacements sooner than originally planned.

Guidelines for Personnel Support

While many of the technological devices described throughout this report are intended for direct use by faculty members or students, it must be recognized that the extensive use of technology in education creates the need for specialized personnel in the areas of operation, maintenance, administration, and materials production. Upon superficial examination, it may appear that such personnel represent expensive additions to the staff of a college, but the increased payroll expense incurred for technological specialists can usually be justified through increased efficiency in the use of teaching personnel and through increased educational effectiveness.

The number of supporting personnel required for a technological system depends, rather obviously, upon the size and complexity of the system, and the capabilities of the people who use it. As a "rule of thumb," any college with an investment in excess of $50,000 in technological facilities can probably justify the hiring of a "chief engineer," whose qualifications should be commensurate with his responsibilities. For a relatively simple system, a well-trained, experienced technician may provide all the technical support that is required, but major systems including a wide diversity of equipment (such as television studios, radio studios, television tape recorders, major distribution facilities, and the like) should be operated under the guidance of a full-fledged graduate engineer. If a broadcast transmitter is involved, employment of at least one engineer holding an appropriate FCC license is required by law. While student labor can be used for many simple operational tasks, it is desirable to employ full-time technicians to operate and maintain equipment of such complexity that considerable training is required, such as television tape recorders, film recorders, and other control-room equipment. The best sources of information as to the number and qualifications of operating personnel required for specific systems or types of equipment, are institutions with prior experience in the operation of the same or related equipment, although manufacturers can usually give valuable guidance.

A small college with limited technical resources may find it desirable to obtain service contracts from manufacturers or service organizations for routine maintenance of equipment, but it is usually wise to encourage the training of local personnel in servicing procedures so as to assure prompt emergency service when equipment becomes disabled. As a general rule, the technical skill required for maintenance of most equipment is greater than the skill required for routine operation. If operational schedules are not too demanding, it is frequently possible to upgrade operating personnel to maintenance personnel as they acquire experience. One important qualification for the chief engineer of a complex system is the ability to train subordinates. Under the guidance of a good chief engineer, slack time in operational schedules can be put to very good use in the study of instruction books and other technical literature and in systematic "check-outs" of equipment with test instruments to gain familiarity.

If a college intends to encourage campus-wide use of technological facilities, it is generally wise to place administrative control of such facilities in the hands of a separate department which reports directly to the administrative head of the college. If the facilities are operated in conjunction with one of the regular academic divisions or departments of the college, there is an increased chance that interdepartment rivalries may influence decisions concerning the use of the facilities, or the actions of the facilities "manager" (whatever his title) may be more subject to misinterpretation. In a small college with relatively modest technological facilities, the chief engineer may be qualified to handle most administrative duties directly, but it would generally be found more satisfactory to have the chief engineer report to a manager who concentrates on the non-technical aspects of the operation. In addition to the supervision of technical operations and maintenance, the major administrative functions include: (a) scheduling the use of facilities, (b) inventory control for both equipment and materials (including the important "library" function), (c) cost accounting, (d) supervision of materials production, and (e) the continual planning of revisions and expansion in the systems.

The need for full-time specialists in the materials production area depends both upon the degree to which instructional materials are locally-generated, and upon the skills available in the existing departments of the college. In most colleges, it would probably be found necessary or desirable to employ at least one graphic artist and at least one full-time photographer to supplement the resources of the normal art and photographic departments. While the college may have several faculty members or graduate students who are highly gifted in both these areas, it is generally unwise to divert the attention of faculty members or students from their teaching and learning obligations by making great demands on their time for "production" activities. Likewise, it would probably be worthwhile to engage the services of at least one full-time radio-TV-film director to assist faculty members in producing local instructional programs, even though outstanding talent in this area may already be available on the teaching faculty. Excessive dependence upon personnel who can give only a second-order priority to materials production may seriously hamper efforts to encourage faculty and students alike to take full advantage of technological facilities.

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PART III

SELECTION AND UTILIZATION OF FACILITIES

Chapter 15

SELECTION OF SYSTEMS AND EQUIPMENT FOR THE LEARNING CENTER

Before the entire RCA report was completed, the RCA study team submitted a set of recommended bid specifications for electronic equipment for the James M. Wood Learning Center (see Appendix A). The trio of consultants retained earlier by the College under the USOE grant offered final comments, the College made necessary modifications and issued final specifications for bid on April 19, 1963. Bidders were given six weeks to reply.

Because the systems included in the specifications were complex and because the specifications were broadly drawn in order to permit imaginative responses, the College called for estimates as well as firm bids. Estimates made possible a preliminary type of bid that left the way open for further negotiation based upon clarification of systems and equipment proposed.

Specifications were submitted to 53 probable suppliers. These suppliers were selected on the basis of known ability to produce quality equipment or to design communication systems. Numerous responses were received, eleven of which were chosen for further consideration. Few bidders were able to bid on the entire installation. Foreseeing this likelihood, the sub-contract team from RCA Educational Advisory Services had written the specifications as a series of eight alternates and suppliers were given the opportunity to bid on any or all or parts of the alternates.

Again, because the systems were complex, the College was advised to name a prime contractor for the entire project. However, choice was finally narrowed to two suppliers, one for sound and television systems, another for audio-visual classroom systems. Each supplier accepted responsibility for compatibility between systems and certain problems were alleviated when both suppliers agreed to use the same electrical sub-contractor for the installation.

On the initial submission, estimates ran to $415,000, many times the budgeted figure. It became immediately apparent that further modifications would be necessary. (In its report, the RCA team had indicated that it might cost $800,000 to fully equip the Learning Center. When specifications were drawn, minimum systems were included for bid with recognition that additional adjustments would have to be made.) A priority list had been compiled by the College previous to the issuance of bids and that listing was applied to the bids. Alternate F, the audio distribution system, was eliminated first because the coaxial cable distribution system provides for r.f. audio distribution as well as video distribution. It was decided that additional audio cable could be added in the future as capacity of the coaxial system was realized.

First priority was given to the coaxial cable distribution system, for it provides the basic dissemination network for the center. Second priority was given to classroom systems and to audio and video facilities for studios and assembly halls. Because none of these alternates could be eliminated in entirety without seriously hampering the effectiveness of the Center, adjustments were made in the total number of equipment units purchased and in initial capacity of the system.

It should be emphasized at this point that the initial desire for quality equipment was never compromised and that no equipment was knowingly purchased which would be obsoleted by system expansion. The College preferred to cut the number of similar units of equipment purchased rather than retain the number desired at the expense of reduced quality. In some instances if a quality unit could not be retained because of cost, purchase was postponed until such time as funds become available. In no instance was a unit purchased if future building block requirements could not be met. For example, although the 2 x 2 automatic slide projectors purchased do not now have random access, that feature can be provided at additional cost in the future without obsoleting either the basic projector or the monetary investment in it.

In some instances the quality desired was simply not available in existing equipment and the College accepted existing items rather than bear the expense of designing prototypes.

Although the College feels that it has not compromised with quality, this will not be definitely known until the systems are in operation. It has confidence in the ability and integrity of the suppliers. The performance characteristics as published by the manufacturers should provide excellent systems. Because many of these systems are affected by the spaces in which they are used, final determination can only be made when the systems are installed and operating.

Because quality is so difficult to define, depending as it does on individual interpretation, the degree of acceptable quality will vary from institution to institution. The television system selected for the Learning Center represents this "concept of quality" dilemma. Basically, there are two types of video cameras used in the industry, the image orthican (IO) used almost exclusively by broadcasters and the vidicon used almost exclusively by closed-circuit telecasters. Each system has certain advantages and disadvantages. To the educator the primary advantage of the vidicon system is its lower initial cost and lower operational and maintenance costs. The IO camera provides more production latitude than the vidicon in that it does not compress the signal as drastically and so is able to deliver a greater contrast range. But the educator chooses the vidicon primarily because of cost and simplicity.

For that matter, the educator would most certainly prefer transmission of color rather than black and white for use in certain courses such as chemistry or art in which color might play an important role. However, he does compromise with quality when he selects black and white systems rather than color systems, but this is a matter of simple economy. A good color camera costs approximately $45,000 while the best vidicon camera costs approximately $10,000. Until cost is reduced the educator is not likely to invest in color cameras. In addition, color receivers sell for approximately double the price of a good black and white receiver. Thus, the entire investment required for color transmission, although the quality may be superior, cannot yet be considered by the educator unless outside funds are available. The educator limits his use of television to the areas in which black and white can do the necessary job.

The reason the factors of quality and economy are stressed is that they have a strong bearing on the practicality of some of the media proposals being bandied about by educators today when Learning Centers are discussed.

The College early discovered that manufacturers could provide any number of intricate systems for storage and retrieval of information--at a price. Although the College firmly believes that expenditures for instructional media to support instruction is necessary, such expenditure should be defensible on a cost per student basis. In the preliminary Learning Center planning it was suggested that a common storage and retrieval system for visual materials and books might be advisable. This system would enable a student to obtain through any receiver a televised picture of a page in a book or reproduction of a slide. Video systems needed for such a project are now a reality. Requests might be filled using a response mechanism at each receiver or a telephone dial. The information requested would then appear on the television screen for use b the student. However, this kind of availability entails tying up an entire transmission system including a television camera, a transmitter, a transmission line and a receiver for the use of one student. If several hundred students wished to use the same materials simultaneously, this might be economically feasible. However, it is fairly evident that it might be less expensive to provide a student with his personal copy of the slide or a free copy of a book rather than to provide such expensive dissemination, however possible such an installation may be.

The same standard of quality and economy was applied to other items included in the approach to systems. Some systems are indeed too expensive when one considers the immediate state of the art and the supply of instructional materials or "programming" available for some of the systems. However, the College also recognized that a start needed to be made and that, hopefully, full utilization would be achieved for the systems purchased within a few years. For example, six teacher consoles have been purchased for the classrooms in the Learning Center, although seventeen rooms are equipped to accept the consoles. The College has limited purchase to a minimum number of units in order to test the systems and to provide for basic utilization of the classrooms. These consoles are movable so they may be placed in any of the available classrooms. Undoubtedly, after using these initial models certain modification in the consoles will appear desirable and these modifications can be made available on new units purchased as the Learning Center utilization increases.

The College will also forego the use of complex response systems although it has provided conduit necessary for future installation of such systems in auditoriums. An elaborate storage and retrieval system has also been postponed in favor of providing a library in which slides, filmstrips and motion pictures can be easily checked out by students and projected on small portable units individually loaned to each student as needed. Thus, the luxury of transmitting our information on an individual basis beyond the confines of our resources library is foregone. The dissemination system has been reserved for group use rather than for individual use.

After a series of evaluations and conferences with suppliers, bids were finally awarded to General Electric Company for the coaxial cable distribution system and for Alternates A, B, C, D, E (assembly hall, cinema and multi-purpose room sound systems, radio studio facilities, and audio and video facilities for the television studios). Staples-Hoppman, Inc. was selected for Alternate G, the classroom equipment and control facilities. Alternate F was eliminated for the reasons indicated earlier. As this report is written both companies are assembling the equipment for installation and are engineering necessary systems for operation of the Center.

The reader is referred to Appendix A, section B of each of the Alternates A, B, C, D, E and G and to section C of the specifications for the coaxial cable distribution system, for a description of the various technological functions provided in the

Learning Center complex. And he is referred to Appendix B for the list of specific electronic and mechanical equipment chosen for initial installation in the Learning Center.

It will be evident that there is nothing mysterious about a learning center or multimedia installation. The equipment selected for the Stephens College Learning Center is that which is to be found on the market and which can be supplied by any reputable audio-visual or broadcast distributor. What is unique is that the system has been planned from the beginning, taking into account objectives of the College, the curriculum, the needs of students and faculty and the likelihood of future developments.

The College hopes it has made possible future installations with minimum communication network problems. It has made available an entire range of audio-visual facilities for use by both students and instructors, using equipment which is of high quality and durable and which should provide relatively trouble-free operation for the life of the equipment. Although the systems are complex, the operation is relatively simple for both instructor and student.

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Chapter 16

SOME CONCLUDING CONSIDERATIONS

This report on The Planning of Educational Media for a New Learning Center presents guidelines for others through both explicit and implicit statements. It uses the individual case of the Stephens College Learning Center as a concrete example. Through the presentation of this case, the planning of educational media systems for new facilities is seen as necessarily and appropriately related to the most basic characteristics, purposes and objectives of an institution. Educational media are thought of and treated as integral parts of architectural and educational planning.

To present this planning realistically and meaningfully, the report includes discussion of the College itself, its objectives and needs, a description of the facilities, a technological analysis of the status of educational media in higher education and analyses and recommendations of a team of technological experts concerning the entire range of educational media and the provisions to be made for them in planning new buildings and facilities.

Many visitors to the Learning Center, even those having conceptual familiarity with its purpose and complex integrated design through verbal descriptions, attest that what it is and how it functions is demonstrated and understood best through personal visitation. Nevertheless, its planning and this report reveal certain guidelines that merit serious consideration by those planning new facilities for higher education. These are restated briefly below.

1. Architectural plans and the educational media facilities they incorporate should be harmonious with institutional characteristics and functionally related to the institution's major educational goals. Chapters 2 and 4 present such considerations.

2. The buildings planned and the media chosen for incorporation should be realistically related to the specific objectives of courses taught. Chapter 3 includes several examples of such analyses and Chapter 4 instances of planning.

3. The physical facilities and the media systems should be highly adaptable to the long future. They should meet the criteria at least of *flexibility*, of *variety*, of as *close proximity* as possible of student, teacher, materials and spaces, and of *easy availability* of the multiple resources for learning. These principles are referred to and exemplified repeatedly in Chapter 4 and again in Part II, chapters 5-12.

4. The planning for installation and use of educational media should be in harmony with theoretical and applied technological knowledge. The case for this is strongly presented in Part II, Chapter 6.

5. The inclusion of educational media should be determined and dictated by the design of specific technological systems created for the given project. Chapters 7-12 advocate and illustrate this approach.

6. The many decisions regarding both architectural design and educational media incorporation should take into account the practical matters of cost and personnel requirements in relation to objectives and necessary functions.

Chapter 13 and 15 treat these concerns.

7. The entire process of educational analysis of needs, objectives and functions; of architectural design; technological systems design; and the resulting construction and installation should have the benefit of exceptionally careful supervision and consultation by personnel familiar with the educational and technological functions to be served. Chapters 4 and 14 reflect this need.

8. Finally, the institution through its educational leadership should provide its faculty with encouragement and opportunity to rethink its educational objectives and its methodology and to explore and experiment with the newer educational media. Chapters2 and 3 present illustrative instances.

Only in actual use will any new facility reveal its real potential for aiding the teacher and the student in their mutual teaching-learning objective.

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APPENDIX A

SPECIFICATIONS FOR ELECTRONIC EQUIPMENT
for the
JAMES M. WOOD LEARNING CENTER
Stephens College, Columbia, Missouri

Prepared by Educational Advisory Services
RCA Service Company
Radio Corporation of America
Cherry Hill, New Jersey

In accordance with a Subcontract for Technological and Engineering Assistance (dated June 26, 1962) under Contract No. OE 2-16-022 between the United States Government (Office of Education, Department of Health, Education and Welfare) and Stephens College, dated May 9, 1962.

Specifications Completed: March 8, 1963
Modified by Stephens College: April 19, 1963

SPECIFICATIONS FOR ELECTRONIC EQUIPMENT
FOR THE JAMES M. WOOD LEARNING CENTER
STEPHENS COLLEGE, COLUMBIA, MISSOURI

I. INTRODUCTORY STATEMENT

The equipment specified herein is intended for installation in the James M. Wood Learning Center, a complex of five academic buildings designed to make a wide variety of learning resources available to Stephens College students. Since much of the future effectiveness of this Learning Center depends upon the proper functioning of relatively complex electronic systems, it is the desire of Stephens College to encourage the potential suppliers of electronic equipment for this project to submit bids based upon systems engineering, rather than upon simple lists of various equipment items to be assembled by the College. Recognizing that very few companies are qualified to submit bids for all devices or systems required for the Learning Center, the College has subdivided these specifications into seven alternates, and will be pleased to receive bids from potential suppliers for any number of alternates from one to seven. Every bidder should be prepared to accept responsibility as a prime contractor if so designated by the College. (In addition, a separate set of specifications has been prepared for a coaxial cable distribution system, also required for installation in the Learning Center.) In the case of suppliers who feel competent to bid on more than one alternate, prices should be shown for the separate alternates, but Stephens College will be pleased to consider special price considerations that might be offered for combinations of two or more alternates by the same supplier.

To give each potential supplier the best possible opportunity to offer the system or systems he considers best adapted to the requirements of Stephens College, these specifications are based on minimum functions and minimum performance requirements, rather than upon specific equipment items pre-selected by the College. It should be understood that minimums will not necessarily be considered adequate. Preference will be given to suppliers of transistorized equipment. To help each supplier prepare a realistic bid, a separate statement of objectives is presented herein for each alternate. Suppliers are also encouraged to visit Stephens College to obtain first-hand supplementary information on requirements and acceptable approaches, or to make on-the-site measurements. Contracts for each alternate will be awarded on the basis of price, quality, and potential value to Stephens College. Although price will not necessarily be the determining factor, it will be up to each bidder to supply convincing arguments to justify preferential consideration for his proposal. In other words, suppliers must be prepared to show how non-specified features or performance characteristics in excess of the minimum requirements may be beneficial to Stephens College.

II. MINIMUM REQUIREMENTS FOR A RESPONSIVE BID

1. Each bidder must submit a proposal for at least one complete alternate, and must submit evidence of having manufactured or supplied comparable equipment or systems for at least three years.

2. Each bidder must describe completely the system or systems he proposes to provide, including complete technical specifications for all major components of the system. Wherever possible, all major components within a given system shall be the products of a single manufacturer who shall

have produced similar apparatus for at least three years, and shall be supplied through an authorized distributor of the manufacturer.

3. Each bid must be accompanied by a statement by a responsible member of the company, certifying that the equipment offered meets the minimum performance specifications listed herein and such additional specifications as may be claimed by the bidder. Any exceptions to the minimum specifications must be clearly stated.

4. Each bid shall be accompanied by a statement of the manufacturer's or supplier's policies with reference to instruction books, replacement parts, field service, product improvement service, warranties and patent protection. As a minimum warranty, all equipment, including external wiring provided by the supplier, shall be guaranteed for a period of at least one year from the date of final acceptance thereof against electrical or mechanical defects or failures, including cost of labor. It is also required that Stephens College be protected from any and all claims arising from the use of patented applications in any apparatus furnished by the supplier.

5. The cost of installation shall be shown as a separate item for each alternate. Stephens College has a staff of competent technicians, and may elect to undertake a substantial portion of the installation work on its own. Bidders for each alternate are invited to comment on the practicality of such installation by Stephens as compared to installation by the bidder's own technicians or service representatives.

III. CONTRACTOR'S RESPONSIBILITY

1. The successful bidder for each alternate shall be required to submit, before contracts are

signed, complete wiring diagrams, equipment layout diagrams, and such other information as may be required by Stephens College or its architect to assure a good installation, properly coordinated with the architectural design and other facilities. Two copies of complete instruction books (covering both operation and maintenance) shall be supplied for each item of electronic or mechanical equipment.

2. In all cases where installation service is included in the contract for any alternate, it shall be the responsibility of the prime contractor to make all adjustments required to place the system in operation, and to perform such tests as may be required to show compliance with all system specifications.

3. In cases where the actual installation is made by Stephens College, the prime contractor shall remain responsible for resolving, at no additional expense to Stephens, unanticipated problems with respect to such matters as level or impedance matching, compatibility of connectors, and mechanical mounting arrangements. In other words, the prime contractor shall be responsible for components capable of being connected together to form a system which meets the specifications.

ALTERNATE A

ASSEMBLY HALL SOUND SYSTEM

A. Objectives and Brief Description

The sound system specified herein is intended to provide: (1) high-quality audio reinforcement of speech originating within the Assembly Hall,

(2) high-quality amplification and audio reproduction of signals received from outside sources through audio lines or radio facilities, and (3) high-quality reproduction of recorded information in either monaural or stereophonic form. It is also anticipated that the Assembly Hall will be used from time to time for the production of monaural or stereophonic recordings and radio programs when the acoustical properties of a medium-size auditorium are desired. It is expressly the desire of Stephens College to obtain equipment of broadcast quality for this particular system.

Architectural and wiring details for the Assembly Hall Sound System are shown on the following drawings, A-2, A-3, A-26, A-27, E-2, E-3, which will be furnished on request to bidders intending to bid on this alternate.

B. Minimum System Functions

The Assembly Hall Sound System shall include but not necessarily be limited to the functions shown on the single-line drawing (No. W-1) and described in the following list.

1. The system shall include three permanently-installed loudspeaker systems, located to the left and right of the stage and above the stage. It is intended that the left and right speaker systems be used for the distribution of stereophonic sound, and that the center unit be used for speech reinforcement. Wide-range sound from monaural sources shall be distributed from either or both of the two side-stage speaker systems. Bidder should check architectural drawings to determine size of speakers and power output needed. (Enclosures were designed for Altec Lansing or R.C.A. horn speakers.)

2. The system shall provide for the

independent operation of at least two independent program channels, normally connected to loudspeaker systems to the left and right of the stage, or to the two input channels of a dual-track tape recorder.

3. The system must accept simultaneous signals from a minimum of four microphones, which may be located at any of seven input positions (six within the Assembly Hall, as shown on the drawings, and one in the sound control booth). The system shall be supplied less microphones, which will be obtained separately by Stephens College.

4. The system shall include a broadcast-quality turntable equipped for the reproduction of either monaural or stereophonic recordings of up to 12" diameter at 33 1/3 RPM.

5. The system shall include a broadcast-quality audio tape recorder capable of recording and reproducing either monaural or stereophonic program materials.

6. The system shall include two independent inputs for sound track signals from two projectors in the adjacent projection room.

7. The system shall include provision for at least two auxiliary inputs, normally connected to audio lines from the Master Control area in the Learning Center.

8. The system shall include facilities for monitoring both the level and the quality of the signals in the program output channels and any of the input channels.

9. The system shall include a jack panel or approved equivalent means to provide convenient access to all input and output circuits and to provide a means for minor revisions in the basic

system for special applications. It must be possible through this jack panel or equivalent means to arrange connections so that output signals from the Assembly Hall Sound System can be transmitted over a separate pair of audio lines to Master Control at a nominal line level of + 18 dbm.

C. Minimum Performance Requirements

1. The two side-stage amplifier-speaker combinations shall be designed to provide distribution of high-quality stereophonic sound throughout the Assembly Hall under normal audience conditions. Minimum specifications for the power output amplifiers shall be:

Frequency Response: ± 1 db, 20 to 15,000 CPS.
Distortion: Less than 3.5% at rated output for any test frequency between 50 and 5,000 CPS.
Hum and Noise Level: At least 75 db below rated output.

2. The center-stage speaker system shall be designed for speech reinforcement purposes, and shall consist of a cluster of horns (or approved equivalent devices) with sufficient directivity to minimize feedback and the radiation of sound toward sound-reflecting wall and ceiling surfaces. To assure adequate directivity while maintaining speech intelligibility, the center-stage speaker system shall have provision for a smooth roll-off in frequency response at the rate of 12 db per octave below 350 cps. If no separate amplifier is provided for the center-stage speaker system, a practical arrangement for switching or patching the center-stage system to one of the amplifiers normally associated with the side-stage speakers must be provided.

3. Minimum performance specifications for all amplifiers exclusive of the final output amplifiers shall be:

Frequency Response: ± 1 db, 30 to 15,000 CPS.
Distortion: Less than 1% total rms distortion at rated output, 30 to 15,000 CPS.
Hum and Noise Level: 70 db below rated output.

4. The turntable and pickup arm must be suitable for broadcast-type operation with respect to cueing and starting. The pickup arm shall be equipped with a stereo cartridge and diamond stylus of 0.7-mil radius for stereo or microgroove recordings, and means shall be provided for connecting the left and right channels in parallel for monaural recordings. Minimum performance specifications for the turntable and equalized pickup shall be:

Frequency Response: ± 3 db, 30 to 12,000 CPS.
Wow and Flutter: Less than 0.25% peak.
Channel separation at 1,000 CPS: 20 db minimum.

5. The audio tape recorder shall operate at tape speeds of 7.5 or 3.75 inches per second, and shall have provision for half-track monaural recording or playback, dual half-track stereo recording or playback, and playback of 4-track pre-recorded stereo tapes. At least one VU meter shall be provided for monitoring record and playback levels. Since this tape recorder is intended for permanent installation as part of the Assembly Hall Sound System, it need not be provided with independent speakers. Provision shall be made for remote control of the following functions through the audio-visual control panels described

in Alternate F of these specifications: Stop, Play, Record, Fast Forward, Reverse. (An actual remote control panel is not required under this alternate, but wiring requirements for remote controls must be clearly specified by supplier.) Other minimum performance specifications shall be (at 7.5 ips):

Frequency Response: ≠ 2 db, 50 to 15,000 CPS.
Wow and Flutter: Less than 0.2% peak.
Signal-to-Noise Ratio: At least 50 db.
Bias Oscillator Frequency: At least 75 kc.

6. All microphone inputs shall have an input impedance of 150 ohms, and preamplifiers shall be designed for operation with broadcast-type microphones having EIA system ratings (G_M) of -160 db or higher.

7. Sound track and auxiliary inputs shall have an input impedance of 600 ohms, and shall accept signals at any level between -10 and ≠ 18 dbm.

8. All other connections between individual components of the system shall conform to recognized engineering practices in reference to line levels and impedance matching. Supplier must specify levels and impedances proposed for interconnections.

9. The system shall be supplied complete with all power supplies required for operation within specifications from a 60-cps power line at any voltage between 105 and 125 volts.

D. Minimum Mechanical Requirements

1. Loudspeaker systems must conform to

existing architectural limitations of the Assembly Hall and be safely secured. Before contracts are signed, the successful bidder must submit photographs, sketches, or drawings which indicate faithfully the appearance of all exposed portions of the loudspeaker systems. Any deficiences in the existing conduit system which might prevent the installation of fully-concealed wiring for any proposed loudspeaker system must also be identified.

2. All operating controls shall be located in a single console to be placed in the sound control room adjacent to the projection booth at the rear of the Assembly Hall. The turntable shall be mounted at a nominal height of 30 inches, and arranged for convenient operation by an operator seated at the console. If the tape recorder is console-mounted, it shall be arranged for convenient operation from the same seated position. To minimize the need for floor space, Stephens College would prefer a rack-mounted recorder with remote controls located in the console. All amplifiers and other auxiliary equipment not mounted in the console shall be mounted in standard equipment racks in the same general area. Access for servicing racks from rear would be desirable. All equipment housings shall be designed with adequate ventilation to assure that operating temperatures remain within the limits established by the equipment manufacturers.

3. A single panel shall be provided in the audio equipment racks for the control of AC power input to the entire system, with such branch circuits as may be required for the control of power to individual devices or sections of the system. Over-current protection shall be provided by circuit breakers.

4. Supplier of this alternate shall provide enough microphone cable of a 3-wire, shielded type for installation in existing conduits to

microphone input connection points at six locations in the Assembly Hall. The microphone cable shall have insulation over the shield to prevent accidental contact between the shields of adjacent cables or the conduit walls. Microphone circuits are to be so connected that no ground currents flow through the cable shields (that is, shields are to be grounded at one end only; the third wire within the cable is to be used for ground connection to the microphone case).

5. Microphone input connectors shall consist of Cannon Type XLR-3-31 3-pin female receptacles mounted on stainless steel plates compatible with the existing outlet boxes and plainly marked "MICROPHONE."

6. With respect to inputs from projector sound tracks and from Master Control, the supplier of this alternate shall be responsible only for providing suitable connection points at the jack field (or approved equivalent facility).

ALTERNATE B

SOUND SYSTEM FOR CINEMA LABORATORY AND MULTI-PURPOSE ROOM

A. Objectives and Brief Description

The sound system described in this alternate is intended to serve two basic rooms, one of which may be further subdivided into two separate rooms by an operable wall. All rooms are small enough that there is no significant need for speech reinforcement within a single room, but the sound system specified herein is required for: (1) the pickup of audio program materials originating in any of the rooms for recording or broadcast purposes, (2) the amplification and distribution within any of the rooms of audio signals received from outside sources, and (3) the reproduction of recorded information in either monaural or stereophonic form. Because these rooms will be used for a wide variety of purposes, it is the desire of Stephens College to obtain a highly flexible sound system, utilizing components of broadcast quality.

Architectural and wiring details for this sound system are shown on the following drawings, A-7, A-27, E-7, E-11, which will be furnished on request to bidders intending to bid on this alternate.

B. Minimum System Functions

The sound system for the Cinema Laboratory and Multi-Purpose Room shall include but not necessarily be limited to the functions shown on the single-line drawing (No. W-2) and described in the following list.

1. The system shall include two permanently-mounted loudspeaker systems in the Cinema Laboratory, installed to the left and right of the stage area, as shown on the drawings. These speakers are intended for the distribution of either stereophonic or monaural program materials.

2. The system shall include two permanently-installed loudspeaker systems in the Multi-Purpose Room, mounted at the locations shown on the drawings. These speakers shall permit distribution of stereophonic program materials when the Multi-Purpose Room is used as a single large room, and shall permit the distribution of two independent monaural signals when the operable wall is closed, forming two separate rooms.

3. The system shall provide for the independent operation of at least four program channels, normally connected to the four loudspeaker systems, but with alternative arrangements for connecting any of the program channels to the inputs of an audio tape recorder or transmission lines to the Master Control area in the Learning Center.

4. The system shall include at least two four-input mixing amplifiers, either of which may be connected to any of the four program channels. The system shall include the necessary preamplifiers or loss pads to make it possible to apply signals from any program source in the system to any of the mixer inputs or directly to any of the program channels.

5. The system must accept simultaneous signals from a minimum of four microphones, which may be located at any of 6 basic positions (three locations within the Cinema Laboratory, two locations in the Multi-Purpose Room, and one in the control booth between the two rooms). System is to be supplied less microphones.

6. The system shall include a broadcast-quality turntable equipped for the reproduction of either monaural or stereophonic recordings of up to 12" diameter at 33 1/3 RPM.

7. The system shall include a broadcast-quality audio tape recorder capable of recording or reproducing either monaural or stereophonic program materials.

8. The system shall include four independent inputs for sound-track signals from four projectors in the adjacent projection room.

9. The system shall include terminal facilities for four 600-ohm lines from the Master Control

area which may be used for either the reception or transmission of up to four independent signals at nominal line levels of + 18 dbm.

10. The system shall include facilities for monitoring both the level and the quality of the signals in any of the program output channels and any of the input channels by speaker or headphone. To facilitate independent use of the Cinema Laboratory and Multi-Purpose Room simultaneously, at least two independent monitoring facilities shall be provided for the program channels normally serving these areas.

11. The system shall include a minimum of two two-way dividing networks and one four-way dividing network to make possible the distribution of any single program source to any two or all four of the program channels. Amplifiers in the system must have adequate reserve gain to compensate for the losses introduced by the dividing networks.

12. The system shall include a jack panel or approved equivalent means to provide convenient access to all input and output circuits and to provide a means for minor revisions in the system for specific applications.

C. Minimum Performance Requirements

1. All power amplifier-speaker combinations shall be designed to provide high-quality distribution of sound throughout their respective rooms under normal audience conditions. Minimum specifications for the power output amplifiers shall be:

Frequency Response: ± 1 db, 30 to 15,000 CPS.
Distortion: Less than 2% at rated output for any test frequency between 50 and 5,000 CPS.

Hum and Noise Level: At least 70 db
below rated output.

2. The minimum performance requirements stated in Items C-3 through C-9 of Alternate A also apply to the Sound System for the Cinema Laboratory and Multi-Purpose Room, and are hereby incorporated into this alternate. The reference to the Assembly Hall Sound System in Item C-5 should obviously be changed to refer to the sound system covered by this alternate.

D. Minimum Mechanical Requirements

1. Loudspeaker systems must conform to existing architectural limitations of the Cinema Laboratory and Multi-Purpose Rooms. Before contracts are signed, the successful bidder must submit photographs, sketches, or drawings which indicate faithfully the appearance of all exposed portions of the loudspeaker systems. Any deficiencies in the existing conduit system which might prevent the installation of fully-concealed wiring for any proposed loudspeaker system must also be identified.

2. All operating controls for the sound system specified herein shall be centralized in the area designated for sound equipment in the control booth between the Cinema Laboratory and the Multi-Purpose Room. To facilitate independent operation of the two basic rooms, the control position shall be designed for use by either one or two operators. The turntable shall be mounted at a nominal height of 30 inches, and arranged for convenient operation by either of two seated operators. The tape recorder shall be rack-mounted with controls arranged to permit convenient operation by either of the two operators. All amplifiers, jack panels, and other auxiliary equipment not mounted in the operating console shall be mounted in standard equipment racks in the same general area of the

control room. Before contracts are signed, the successful bidder must submit photographs, sketches, or drawings which indicate faithfully the appearance of the proposed control positions.

3. All equipment housings shall be designed with adequate ventilation to assure that operating temperatures remain within the limits established by the equipment manufacturers.

4. A single panel shall be provided in the audio equipment racks for the control of AC power input to the entire system, with such branch circuits as may be required for the control of power to individual devices or sections of the system. Over-current protection shall be provided by circuit breakers.

5. Supplier of this alternate shall provide enough microphone cable of a 3-wire, shielded type for installation in existing conduits to microphone input connection points at three locations in the Cinema Laboratory and two locations in the Multi-Purpose Room as shown on the drawings. The microphone cable shall have insulation over the shield to prevent accidental contact between the shields of adjacent cables or between the cable shields and the conduit walls. Microphone circuits are to be so connected that no ground currents flow through the cable shields. (That is, shields are to be grounded at one end only; the third wire within the cable is to be used for ground connection to the microphone case.)

6. Microphone input connectors shall consist of Cannon Type XLR-3-31 3-pin female receptacles mounted on stainless steel plates compatible with the existing outlet boxes and plainly marked "MICROPHONE."

7. The supplier of this alternate shall be responsible for providing at the jack field (or

approved equivalent facility) suitable connection points for lines bringing in the projector sound track signals and remote signals from Master Control.

ALTERNATE C

RADIO STUDIO SYSTEMS

A. Objectives and Brief Description

The systems specified herein are intended to make possible the origination of either stereo or monaural audio programs for broadcast, closed-circuit transmission, or recording purposes. Two independent, nominally identical systems are required for installation in the radio studio section of the Learning Center. The several radio studios will be used both as "laboratory" facilities for classes in radio broadcasting and as production facilities for locally-produced programs. Stephens College is considering the eventual acquisition of an FM broadcast transmitter, and the studio equipment specified herein may thus become part of the facilities of a full-fledged broadcast station. It is therefore the desire of Stephens College to obtain broadcast-quality equipment for this installation. The College prefers to remove and install an existing monaural system in one of the radio studios. Bidders are requested to quote on one stereo system only rather than two as indicated.

Architectural and wiring details for the radio studio systems specified herein are shown on the following drawings, A-2, A-26, E-2, and will be supplied on request to bidders intending to bid on this alternate.

B. Minimum System Functions

The radio studio systems shall include but not necessarily be limited to the functions shown on the single-line drawing (No. W-6) and described in the following list.

1. Each of the two systems shall provide a minimum of two program channels, normally used for the left and right signals of stereophonic program materials.

2. Each of the two systems shall provide for the simultaneous operation of a minimum of six microphones, selected from a minimum of six permanently-installed inputs. The systems are to be supplied less microphones, which will be obtained separately by Stephens College.

3. Each of the two systems shall include two broadcast-quality turntables equipped for the reproduction of either monaural or stereophonic recordings of up to 12" diameter at 33 1/3 RPM.

4. Each of the two systems shall include a broadcast-quality audio tape recorder capable of recording and reproducing either monaural or stereophonic program materials.

5. Each of the two systems shall include provision for at least two auxiliary inputs, normally connected to audio lines from the Master Control area in the Learning Center.

6. Mixing facilities for each of the two systems shall make possible simultaneous use of a minimum of six signal sources, not counting the separate channels of stereo input devices. Mixer controls for turntable and tape inputs shall be arranged so that the levels of the left and right channels can be adjusted either simultaneously or independently.

7. Each of the two systems shall include facilities for monitoring both the level and the quality of the signals in either of the program output channels. Stereo monitor speakers shall be provided in each studio and control room. Muting relays or equivalent devices shall be connected to microphone switches to prevent acoustical feedback.

8. Each of the two systems shall be so arranged that it is possible to connect the two output channels either to a pair of lines to the Master Control area or to the two inputs of the stereo tape recorder, or to both simultaneously.

9. Each bidder is requested to show, as an optional item, variable audio compensator facilities which might be used to alter the frequency response characteristics of the systems to compensate for microphone pickup deficiences or to obtain special effects. Provision should be made for the separate compensation of the two program channels in each system. The bid for this option must include any additional amplifiers, matching pads, switches, jack panels, or other devices required for the convenient insertion and removal of the audio compensator facilities.

C. Minimum Performance Requirements

1. All amplifiers which handle program signals shall have flat frequency response (≁ 1 db) from 30 to 15,000 cps. Total rms distortion from 50 to 15,000 cps shall be less than 0.5% for preamplifiers and line amplifiers, less than 1.0% for monitoring amplifiers at 10-watt output level. Hum and noise level shall be less than -110 dbm at preamplifier inputs, at least 70 db below the rated output of line amplifiers and monitoring amplifiers.

2. All turntables and pickup arms must be

suitable for broadcast-type operation with respect to cueing and starting. Each pickup arm shall be equipped with a stereo cartridge and diamond stylus of 0.7-mil radius for stereo or microgroove recordings, and means shall be provided for connecting the left and right channels in parallel for monaural recordings. Minimum performance specifications for the turntable and equalized pickup shall be:

Frequency Response: ± 3 db, 30 to 12,000 cps.
Wow and Flutter: Less than 0.25% peak.
Channel separation at 1,000 cps: 20 db minimum.

3. Each of the audio tape recorders shall operate at tape speeds of 7.5 or 3.75 inches per second, and shall have provision for half-track monaural recording or playback, dual half-track stereo recording or playback, and playback of 4-track pre-recorded stereo tapes. Each recorder shall include at least one VU meter for monitoring record and playback levels; separate VU meters for the two channels are preferred. Since these tape recorders are intended for permanent installation as components of studio systems, they need not be equipped with independent speakers. Minimum performance specifications at 7.5 ips shall be:

Frequency Response: ± 2 db, 50 to 15,000 cps.
Wow and Flutter: Less than 0.2% peak.
Signal-to-Noise Ratio: At least 50 db.
Bias Oscillator Frequency: At least 75 kc.

4. All microphone inputs shall have an input impedance of 150 ohms, and preamplifiers shall be designed for operation with broadcast-type microphones having EIA system ratings (G_M) of -160 db or higher.

5. All remote or auxiliary inputs shall have an input impedance of 600 ohms, and shall accept signals at any level between -10 and + 18 dbm.

6. All other connections between individual components of the system shall conform to recognized engineering practices in reference to line levels and impedance matching. Supplier must specify levels and impedances proposed for interconnections.

7. The system shall be supplied complete with all power supplies required for operation within specifications from a 60-cps power line at any voltage between 105 and 125 volts.

D. Minimum Mechanical Requirements

1. All operating controls for each of the two systems shall be centralized in a single console located in the appropriate control room. Turntables shall be mounted at a nominal height of 30 inches, and shall be arranged for convenient operation by an operator seated at the console. The tape recorders may be either console-mounted or rack-mounted, but controls must be readily accessible to the seated console operator (remote controls if necessary). Any auxiliary equipment not mounted in the console shall be mounted in standard equipment racks provided by the supplier.

2. All equipment housings shall be designed with adequate ventilation to assure that operating temperatures remain within the limits established by the equipment manufacturers.

3. A centralized panel shall be provided in each of the two systems for the control of AC power input to the entire system, with such branch circuits as may be required for the control of power to individual devices or sections of the

system. Over-current protection shall be provided by circuit breakers.

4. Supplier of this alternate shall provide enough microphone cable of a 3-wire, shielded type for installation in existing conduits to microphone input connection points in all studios and announce booths. The microphone cable shall have insulation over the shield to prevent accidental contact between the shields of adjacent cables or between the cable shields and the conduit walls. Microphone circuits are to be so connected that no ground currents flow through the cable shields. (That is, shields are to be grounded at one end only; the third wire within the cable is to be used for ground connection to the microphone case.)

5. Microphone input connectors shall consist of Cannon Type XLR-3-31 3-pin female receptacles mounted on stainless steel plates compatible with the existing outlet boxes and plainly marked "MICROPHONE."

6. Supplier of this alternate shall provide enough cable of a 2-wire, shielded type to make all connections to monitor speakers in studios, control rooms, and announce booths.

7. With respect to the remote lines to and from the Master Control area, the supplier of this alternate shall be responsible only for providing suitable connection points at the console or at a jack field.

ALTERNATE D

AUDIO FACILITIES FOR TELEVISION STUDIOS

A. Objectives and Brief Description

The systems specified in this alternate are required to pick up the audio portion of television programs originating in television studios in the Learning Center. Since there are two studios, two independent, nominally-identical audio systems are required. In contrast to the systems described in Alternates A, B, and C, the systems specified here are intended only for monaural operation.

Architectural and wiring details for the television studio audio systems specified herein are shown on the following drawings, A-2, A-3, A-26, E-2, which will be supplied on request to bidders intending to bid on this alternate.

B. Minimum System Functions

The television studio audio systems shall include but not necessarily be limited to the functions shown on the single-line drawing (No. W-7) and described in the following list.

1. Each of the two systems shall provide for the simultaneous operation of a minimum of five microphones, selected from a minimum of seven permanently-connected microphone inputs. The systems are to be supplied less microphones, which will be obtained separately by Stephens College.

2. Each of the two systems shall include a broadcast-quality turntable equipped for the monophonic reproduction of either monaural or stereophonic recordings of up to 12" diameter at 33 1/3 RPM.

3. The facilities shall include a single broadcast-quality audio tape recorder arranged with dual remote controls to permit operation from the normal operating positions of either of the two systems.

4. Each of the two systems shall include a

minimum of four auxiliary inputs, two of which shall be normally connected to film projectors in the Master Control area. The third auxiliary input is intended for the occasional use of an additional audio source, such as a second turntable or an additional tape recorder, and the fourth shall be normally connected to a spare line from Master Control.

5. Each of the two systems shall include facilities for monitoring both the level and the quality of the signals in the program output channel or in any input channel. Monitor speakers shall be provided in each studio, announce booth, and control room. Muting relays or equivalent devices shall be connected to microphone switches to prevent acoustical feedback.

6. Each of the two systems shall be so arranged that it is possible to connect the program output channel either to a line leading to the Master Control area, to the input of the audio tape recorder, or to both simultaneously.

7. Each bidder is requested to show, as an optional item, variable audio compensator facilities which might be used to alter the frequency response characteristics of each system to compensate for microphone pickup deficiences or to obtain special effects. The bid for this option must include any additional amplifiers, matching pads, switches, jack panels, or other devices required for the convenient insertion and removal of the audio compensator facilities.

C. Minimum Performance Requirements

1. The minimum performance requirements stated in Items C-1 and C-4 through C-7 of Alternate C also apply to the audio systems for the television studios, and are hereby incorporated into this alternate.

2. Each turntable supplied under this alternate must be suitable for broadcast-type operation with respect to cueing and starting. Each pickup cartridge shall be equipped with a diamond stylus of 0.7-mil radius to permit the monophonic playback of either stereo or monaural microgroove recordings. Minimum performance specifications for the turntable and equalized pickup shall be:

Frequency Response: ± 3 db, 30 to 12,000 cps.
Wow and Flutter: Less than 0.25% peak.

3. The audio tape recorder shall operate at tape speeds of 7.5 or 3.75 inches per second, and shall have provision for half-track monaural recording or playback. The recorder shall include at least one VU meter for monitoring record and playback levels. Since the recorder is intended for permanent installation as part of a studio system, it need not be equipped with an independent speaker. Minimum performance specifications at 7.5 ips shall be:

Frequency Response: ± 2 db, 50 to 15,000 cps.
Wow and Flutter: Less than 0.2% peak.
Signal-to-Noise Ratio: At least 50 db.
Bias Oscillator Frequency: At least 75 kc.

D. Minimum Mechanical Requirements

1. All operating controls for each of the two systems shall be centralized in a single console located in the appropriate control room at a position which permits visual observation of the studio floor. Turntables shall be mounted at a nominal height of 30 inches, and shall be arranged for convenient operation by operators seated at

the consoles. Each operating position shall include remote controls for the single audio tape recorder, which shall be rack-mounted, along with any other auxiliary equipment not mounted in the consoles, in standard equipment racks provided by the supplier.

2. Items D-2 through D-7 in the list of minimum mechanical requirements for Alternate C also apply to the television studio audio systems, and are hereby incorporated into this alternate.

ALTERNATE E

VIDEO EQUIPMENT FOR TELEVISION STUDIOS

A. Objectives and Brief Description

The Stephens College Learning Center includes two television studios which are to be used both as "laboratory" facilities for classes in television broadcasting and as production facilities for programs to be broadcast, transmitted via closed-circuit facilities, or recorded on tape or film.

Stephens College already owns a television studio equipped with two RCA TK-15 live vidicon camera chains, an RCA TK-21 film chain, an RCA TP-11 multiplexer, two Bell and Howell television film projectors, a Spindler and Sauppe slide projector, an RCA TS-5 switcher, a pair of synchronizing generators with changeover switch, and monitoring equipment. It is the desire of Stephens College to relocate and utilize as much of this existing equipment as practical in the new installations to be made in the Learning Center, but significant quantities of new equipment will be required to equip a second studio and to provide additional functions not available with the present equipment. It is also the desire of Stephens College to integrate the two studio systems as fully as possible to gain economy and flexibility without sacrificing independence of operation during periods when both studios must be in operation simultaneously. To assure a properly integrated system, the supplier of this alternate shall be expected to plan a total system utilizing both the existing equipment and proposed new equipment. Stephens College will consider replacing specific items of existing equipment in cases where a bidder can show that it is in the best interests of the College to do so. Because of the complexity of television studio systems and the relatively great investments involved, prospective bidders for this alternate are strongly urged to visit the Stephens campus to obtain first-hand knowledge of the requirements and to make whatever evaluation may be required of the existing television studio equipment.

Architectural and wiring details for the television studio video systems are shown on the following drawings, A-2, A-3, A-26, E-2, E-3, which will be furnished on request to bidders intending to bid on this alternate.

B. Minimum System Functions

The television studio video system shall include but not necessarily be limited to the functions shown on the functional block diagrams (Drawings Nos. W-3, W-4, W-5) and described in the following list. These specifications describe the complete system, utilizing both existing and new equipment. The system shall be supplied with all tubes, lenses, power supplies, cables, connectors, racks, console housings, and other auxiliary equipment required to form a complete, operable system.

1. The system shall include a total of five broadcast-quality vidicon cameras with viewfinders. It is intended that three of these cameras be normally assigned to Studio A and the remaining two to Studio B, but provision shall be made (as specified in Item 4 below) for the occasional use of cameras in other areas. Each camera shall have a lens turret capable of accepting a minimum of four lenses, and new cameras supplied under this alternate shall be equipped with lenses of 1, 2 and 4 inch nominal focal length lenses (C-mount). (The fourth turret position is to be used for other lenses obtained separately by Stephens College.) The turret position shall be controllable from the rear of the camera, and the turret diameter shall be great enough to accommodate simultaneously without optical interference a lens of 25 mm focal length and a Type B-2, f/2.4 Berthiot Zoom Lens or equivalent. There shall also be provision for controlling standard television-type zoom lenses from the rear of the camera, preferably through the use of a hollow turret-control shaft to accommodate the zoom-lens control rod. Balanced cradle mounts are desired.

2. Mounting equipment for the three new live cameras to be supplied under this alternate shall consist of three studio pedestals, of the Houston-Fearless Type PD-5A or equivalent.

3. All camera control equipment is to be located in the Master Control Room with control panels so grouped that video operating functions may be performed by either one or two video operators, depending upon program requirements. To facilitate level matching, the video control facilities shall include a switching arrangement to permit the output of any camera chain (live or film) or the output of either studio to be inspected on a single master monitor.

4. The system shall include a camera

cable patch panel or coaxial switch panel in the Master Control Room for the convenient revision of camera cable circuits between the live cameras and the camera control units (or processing amplifiers). Fittings on the camera cable patch panel may consist of standard female camera cable connectors, and cables running directly to the camera control units may be employed as "patch cords." The patch panel for the initial installation shall include fittings for four permanently-installed camera cable lines to Studio A and three permanently-installed camera cable lines to Studio B. (In addition, the patch panel shall provide space for the future installation of a minimum of five additional connectors to terminate camera cable runs that may be installed in the future to other locations in the Learning Center.)

5. The system shall include one television film chain, in addition to that owned by the College, each of which shall be equipped with an optical multiplexer, a remotely-controlled 16-mm film projector, and a remotely-controlled 2 x 2-inch slide projector with a capacity of at least 36 slides. It would be preferable to have random selection and higher capacity. The film cameras shall be equipped with automatic sensitivity control, and multiple remote control panels shall be provided (with a suitable delegation arrangement) to permit operation of any of the projection devices from any of three locations: (a) the Master Control Room, (b) the control room for Studio A, or (c) the control room for Studio B.

6. The system shall include a pair of synchronizing generators (owned by the College) delivering standard pulse signals conforming to EIA specifications. The sync generator system shall include a remotely-controlled changeover switch and such pulse distribution amplifiers as may be required to synchronize all video

equipment from a single source at any given time.

7. Independent program-assembly control positions shall be provided for the two studios, located near the control-room windows to permit direct visual observation of the studios. At each position, a row of 14- to 17-inch picture monitors shall be provided to permit continuous inspection of all normal input signals and the studio output signal.

8. Switching facilities for Studio A shall include means for obtaining direct "cuts," fades to and from black, lap dissolves, and superimpositions of any two input picture signals. As an alternate item it would be desirable to incorporate self-keyed video insets and special effects, including wipes and split-screen displays. In addition, there shall be a preview bus permitting display of any signal source of the outputs of mixing or effects equipment on a single picture monitor and waveform monitor. Input channels shall be provided for three live cameras, two film cameras, black, solid white, and test signals from Master Control. At least one spare picture-input channel shall be provided for occasional use of a fourth camera from Studio B. In the interests of economy, Stephens College is prepared to accept so-called "direct" switching equipment, but will consider optional bids for remotely-controlled switching equipment of superior performance or flexibility. An acceptable arrangement of switching facilities is shown in Drawing No. W-3.

9. Switching facilities for Studio B shall include means for obtaining direct "cuts," fades to and from black, lap dissolves, and superimpositions of any two signal sources. Input channels shall be provided for a minimum of two live cameras and two film cameras. At least one spare input channel shall be provided for test signals

from Master Control or for the occasional use of an additional live camera from Studio A. An acceptable arrangement of switching facilities is shown in Drawing No. W-5.

10. Master Control switching facilities shall make possible the selection of either studio output, either film chain, or the output of two future TV tape recorders as the signal for either of two local channels in the coaxial cable system which distributes television signals throughout the Learning Center. In addition, the master control switcher shall make possible the selection of a signal from either studio, from either film chain, or from a future television tuner (to receive "off-the-air" broadcast signals) as the input for a future television tape or film recorder. The Master Control switching system shall provide means for the interlocked switching of both audio and video signals, either in the form of audio contacts on the video switches or in the form of a "slave" audio switcher employing relays or equivalent devices.

11. The supplier of this alternate shall provide headset-type intercom facilities linking the program director, the technical director (or switcher), an instructor seated near the program director, the audio operator, an announcer (in the announce booth), camera operators, floor managers, the microphone boom operator, video operators, film technicians, and the master control operator. An independent system shall be provided for each studio. In addition to the normal "party line" circuit, each system shall include "private line" circuits linking the technical director to the video operators in the master control room, and linking the audio operator to the boom operator. Means shall also be provided for the program director to make loudspeaker announcements in the studio and to attract the attention of the master control operator through a loudspeaker-type intercom system.

12. The system shall include video patch panels or approved equivalent means to provide convenient access to the outputs of all signal sources, the inputs to all switchers, and to the other circuit points where jack symbols are shown on the functional diagrams.

C. Minimum Performance Requirements

1. All equipment shall be designed for operation from a single-phase a-c power line of 105 to 125 volts, 60 cycles per second.

2. Pulse signal input requirements shall conform to EIA specifications for television synchronizing generator output waveforms, as described in EIA Specifications RS-170.

3. Video output signals from each camera chain and from each studio system shall conform to EIA specifications for television broadcast signals. Standard output level shall be 0.7 volt noncomposite or 1 volt composite across 75 ohms.

4. All vidicon camera chains supplied under this alternate (both live and film) shall conform to the following minimum performance specifications:

(a) Sensitivity (Signal-to-Noise Ratio): The peak-to-peak noise level shall not exceed 3% of the peak-to-peak signal level when observed on an oscilloscope of nominally flat bandwidth to at least 8 megacycles under conditions of 0.1 ua dark current, 0.2 ua signal current and no aperture compensation or gamma correction, utilizing a Type 7038 vidicon. (Vidicons supplied with live cameras shall be Type 7735A; those supplied with film cameras shall be Type 7038.)

(b) Aperture Correction: Each camera chain shall include an aperture correction circuit, preferably of a linear-phase-shift type with a peak of boost between 3.5 and 4.5 mc and the degree of boost adjustable between 0 and at least 6 db.

(c) Resolution and Detail Response: Each camera shall be capable of resolving at least 350 lines vertically and 600 lines horizontally in the central area of the picture. In addition, each camera shall meet the following minimum response specifications for optically-generated square waves under conditions of 0.2 ua signal current and normal aperture compensation and gamma correction. (In no case shall the aperture compensation be set beyond the point causing the response at any line number to exceed 100% or the peak-to-peak noise level to exceed 10% of the black-to-white range established by large areas of black and white in the test pattern.)

Horizontal Resolution (in TV Lines per Picture Height)	100	200	250	300	350	450
Response at Center (%)	100	95	85	70	55	30
Response in Corners (%)	100	90	75	50	20	--

(d) Gamma Correction: Each camera chain shall include a gamma correction circuit capable of modifying the transfer characteristic in the general direction of stretching blacks and compressing whites. It shall be possible to reduce the gamma correction to zero for test and maintenance purposes, and manipulation of the operational gamma correction controls shall not cause the reference white level to vary by more than 10% of the normal blanking-to-reference-white range. The maximum degree of correction shall be nominally equivalent to an exponential curve of 0.5 or smaller, and the maximum gain ratio (amplification for extreme blacks relative to the amplification for extreme whites) shall be at least 10 to 1.

(e) Uniformity of Signal (Shading): The signal level at the output of each camera chain shall not vary in any portion of the raster by more than 5% when the camera lens is removed, a Type 7038 vidicon is illuminated directly by a point source of light (such as a single light bulb at least 8 feet away), and the exposure conditions are adjusted to yield a signal current of 0.2 ua and a dark current less than 0.1 ua.

(f) Geometric Distortion: The camera raster shall be free of distortion to the degree that no point in the image area is displaced from its true position by more than 2% of the raster height as determined by a comparison of the signal generated by scanning the EIA Linearity Chart with an electronically-generated grating signal.

(g) Freedom from "White Line" Effect: The start of the vertical scan retrace shall be delayed relative to the beginning of vertical blanking so as to eliminate the white line at the bottom of the raster.

(h) Deflection Crosstalk: With the lens capped and the video gain set at the value which raises a 0.2 ua signal to normal output level, the amplitude of signals resulting from deflection crosstalk or ringing shall not exceed 0.5% of the blanking-to-reference-white range. In the case of live cameras, the viewfinder shall be in normal operation for this test.

(i) Immunity to Hum and Impulse Noise: Barrier filters if necessary shall be provided on all power and control leads entering the camera to avoid electrical interference picked up along the camera cable. Operating control leads to the camera shall have hum rejection filters having at least 40 db attenuation at 60 cycles. All high-peaking to overcome the capacitance loading of the input load resistor shall be accomplished at the camera end of the camera cable.

(j) Remote Controls: Controls at the remote operating position shall include target voltage (which may be labeled "gain"), pedestal, beam current, and vidicon electrostatic focus. A gain control for the video amplifier is not an acceptable substitute for the target voltage control.

(k) Video Calibration: An operational means for determining dark current and signal current at the vidicon signal electrode shall be built into each camera chain, either in the form of a metering circuit or means for substituting a calibrated signal for the vidicon signal at the amplifier input terminal. If a calibrating signal is employed, it shall represent a known target current swing of nominally 0.3 ua. It is preferred that both extremes of the amplitude swing shall be clearly defined by "dwell times" of at least 10% of the period of the signal.

(l) Pedestal Stability: The picture black level shall not vary by more than ± 1% as a result of ± 5% variations in the power line voltage.

(m) Protection Circuits: Each camera chain shall include means for automatically disabling the beam to prevent damage to the vidicon tube in the event of a failure in either the horizontal or vertical deflection circuit.

5. Each new film camera supplied under this alternate shall be equipped with automatic sensitivity control to maintain an essentially uniform output level for wide changes in scene illumination (or film density). A switch for disabling the automatic sensitivity control shall be provided on the remote control panel. Operation of the automatic sensitivity control shall not introduce video bounce, and must conform to the following minimum performance specifications:

Change in Video Level: Less than 5% for 10 to 1 change in light.
Less than 30% for 100 to 1 change in light.
Less than 10% for change in picture content from all white to 10% white area.

Recovery Time: Less than ½ second after 10 to 1 change in light.
Less than 1 second after 100 to 1 change in light.

6. Each film camera supplied under this alternate shall be equipped with means for reversing the polarity of the video signal through a switch on the remote control panel (to accommodate negative film).

7. The frequency response of each camera control amplifier (exclusive of high-peaking or aperture compensation circuits), isolation amplifier, distribution amplifier, special effects amplifier, or mixing amplifier supplied under this alternate shall be flat within ± 1 db to 8 megacycles. In addition, each such amplifier shall transmit a step-type transition with rise time determined by a Gaussian filter of 4 mc bandwidth at the 6 db point with no leading or trailing overshoot.

8. Each video amplifier (including camera control amplifiers) supplied under this alternate shall transmit a "window" signal consisting of a white area of 50% width and 50% height centered on a black background with not more than 1% tilt as observed at either horizontal or vertical rate. There shall be no visible "smear" or "streaking" before or after the window area as viewed on a picture monitor.

9. The DC voltage on the 75-ohm cables interconnecting the various components of the video system shall not exceed 2 millivolts when terminations are in place nor more than 1.0 volt when the terminations are open, measured under no-signal conditions in both cases. Hum on the interconnecting cables shall not exceed 3% of the blanking-to-reference-white range.

10. All video amplifiers (including pre-amplifiers and camera control amplifiers) shall be stabilized in gain by negative feedback, current stabilization, or some equivalent technique clearly identified by the bidder. In addition, power supplies shall have adequate regulation to assure no detectable change in system performance for power-line voltage variations of ± 5%.

11. Video switching equipment shall provide an overlap type of switching transition, and signal levels shall remain uniform within ± 0.3 db over the frequency band from 30 cps to 4.5 mc during all switching operations. Crosstalk at the output of any switcher bus shall not exceed 46 db.

12. Master monitors shall be capable of displaying pictures with all corners showing on a kinescope of not less than 8 inches nominal diagonal. Horizontal resolution at the center of the picture shall be not less than 600 lines, and full d-c restoration shall be provided. The frequency response of all waveform monitors shall conform to the IEEE roll-off characteristic.

13. The 17-inch display monitors for the studio control positions shall provide center horizontal resolution of not less than 600 lines, full d-c restoration, and provision for the optional display of underscanned pictures with all corners showing.

14. Each slide projector supplied under this alternate shall provide smooth transitions from slide to slide with a change time of not greater than 1/5 second.

15. Each 16-mm film projector supplied under this alternate shall be capable of accepting projection lamps of up to 1000 watts, and shall accept

reels of at least 2,000-ft. capacity. The audio output of each projector shall be at a minimum level of -10 dbm across 600 ohms, and hum and noise in the audio channel shall be at least 50 db below rated output.

D. Minimum Mechanical Requirements

1. Tally lights shall be located on each live camera in such a manner as to be plainly visible from the front of the camera, from above the camera, and within the viewfinder hood.

2. Each live camera shall have a single focus control for all lenses in the form of a knob on the right-hand side of the camera (or an alternative arrangement subject to the approval of Stephens College). The focus control shall be free of backlash, and shall be nonlinear in action such that the amount of linear travel per unit rotation of the focus knob is reduced as the photoconductor is brought closer to the turret plate. The focus adjustment shall not drift or creep in any camera position.

3. All equipment shall be designed to permit inspection, removal, and replacement of all electronic components without major mechanical disassembly. Tip jacks or equivalent test points shall be provided for the rapid and convenient connection of test instruments to all circuit points representing key waveforms or significant voltages.

4. Live cameras shall have adequate cooling by forced air or other means to permit continuous operation without adjustment of other than the remote operating controls for a minimum of 6 hours in an ambient temperature of 35°C and the radiant heating of normal studio lighting after a warm-up period of not greater than 20 minutes. All other

equipment housings shall have adequate ventilation or cooling to permit continuous operation at temperatures within the limits established by the equipment manufacturers.

5. Any television film projector supplied under this alternate shall be designed to permit rapid replacement of either the projection lamp or exciter lamp in a time period not to exceed 10 seconds.

6. The supplier of this alternate shall provide enough camera cable and connectors for installation of four permanent lines to Studio A, three permanent lines to Studio B, and studio cables of 50-foot length for each new camera supplied. Dust caps should be included.

7. The supplier of this alternate shall provide enough 75-ohm coaxial cable and connectors to complete all interconnections between the various components of the video system. If direct switching is employed, the lines between Master Control and the studio control rooms may be of Type RG-59/U cable to minimize bulk in the conduits, but all other interconnections shall be made with Type RG-11/U cable or approved equivalent.

8. A centralized panel shall be provided in the Master Control area for the control of AC power input to the entire system, with such branch circuits as may be required for the control of power to individual devices or branches of the system. Over-current protection shall be provided by circuit breakers.

ALTERNATE F

AUDIO DISTRIBUTION SYSTEM

A. Objectives and Brief Description

The audio distribution system specified herein is intended to provide multiple-channel, closed-circuit distribution of both stereophonic and monaural program materials from the Master Control area of the Learning Center to a great many potential listening locations. While the initial installation is to be confined to the Learning Center, the system must be suitable for eventual expansion to other areas of the campus, including dormitory rooms.

The intended objectives of this audio distribution system include: (a) distribution of lectures or other audio programs originating in the radio studios, Assembly Hall, Cinema Laboratory, or other rooms to remote audiences in rooms located elsewhere in the Learning Center; (b) distribution of amplified telephone interviews and recorded audio instructional materials to multiple classrooms; (c) convenient access by individual students to "assigned" audio materials, including language lessons, musical selections, and certain types of lectures or speeches; (d) distribution of "off-the-air" signals of potential interest or value to Stephens students and faculty members, picked up from domestic AM and FM broadcast stations and from international short-wave stations; (e) distribution of musical programs for general listening enjoyment; (f) distribution of local information services, such as news, weather, and campus announcements; (g) distribution of student-prepared program materials. It is intended that channels in the audio distribution system not fully committed to scheduled program services be made available for "random access" by both students and faculty members to recorded audio materials stored in the Resources Library. While highly-automated random-access devices may be added to the system at some time in the future, it is planned that the initial system provide for random access through the use of one or more human operators in the Resources Library, who would receive requests for specific audio materials via the regular campus telephone system and place the requested materials on audio playback devices linked to the audio distribution system via trunk lines to the Master Control area.

B. Acceptable Approaches and Evaluation Criteria

Because the type of audio distribution system required is relatively unprecedented, and because Stephens College recognizes and desires to evaluate realistically a variety of basic approaches to the audio distribution problem, the specifications for this alternate have been stated as broadly as possible, avoiding detailed requirements that might unduly restrict the freedom of potential suppliers in offering systems which, in their judgment, best meet the present and future needs of Stephens College. The College will be happy to consider bids based on any reasonable approach capable of meeting the minimum system requirements. Among the approaches Stephens College is willing to consider are:

(1) Radio-frequency distribution by frequency-modulation techniques through the same coaxial cables used for the distribution of closed-circuit television signals. (The basic coaxial-cable distribution system is covered in a separate set of specifications, available to bidders for this alternate upon request.) In theory, the conventional FM broadcast band could be utilized in a closed-circuit system to distribute as many as 50 simultaneous audio signals with very high quality

standards; conventional FM tuners could then be used as receiving devices. Stereophonic signals could be handled by a subcarrier technique, comparable to that used in FM broadcasting. It is conceivable that a lower-cost system more suitable for closed-circuit service could be developed by modifying the conventional FM broadcast standards without materially affecting quality.

(2) Audio-frequency distribution, using multi-conductor cables and switches or other signal selection means at each receiving point. In the interests of economy, this approach would probably require the use of a "bridging" approach at most receiving locations, permitting each cable run to serve many receiving locations. Stereo signals would probably require the use of two separate pairs in the transmission cable.

(3) Audio-frequency distribution, employing twisted-pair lines (or the equivalent) and telephone switching techniques. In this approach, at least a single audio pair (more probably a double pair, to provide stereo service) would be required from the Master Control area to each receiving point. Signal selection could be accomplished by a telephone-type dial (or some similar device) at each receiving location, which would remotely control stepping relays or similar switching devices at the Master Control end of the lines to connect the desired signal sources.

Selection of the successful bid for this alternate will be on the basis of: (a) initial cost, (b) anticipated cost of expansion to meet future requirements, (c) anticipated maintenance cost, (d) audio transmission quality, (e) flexibility (variety of useful services provided), and (f) convenience of use. Because of the variety of approaches and the inevitable need for compromises, Stephens College will welcome calls from potential suppliers for discussions of requirements or review of proposals still in preparation.

C. Minimum System Functions

1. The system shall provide for origination of a minimum of 24 monaural or 12 stereo channels. (Pairs of channels may be utilized for stereo, if necessary.) Expansion capability would be most desirable.

2. In the initial installation, outlets for listening are to be provided at locations shown on architects drawing No. RE-3.

At each individual listening point, there shall be means of selecting any of 24 monaural or 12 stereo signals, means for connecting either monaural or stereo earphones, and means for adjusting volume and stereo balance. Supplier of this alternate shall provide 65 pairs of earphones, of which at least 25 shall be suitable for stereo use.

3. Provision shall also be made in the initial installation for outlets in all classrooms shown on the riser diagram for the TV distribution system (Drawing No. RE-3). For all classroom outlets, the supplier of this alternate shall be responsible for providing means for selecting signals and delivering same at a minimum level of -10 dbm across 600 ohms to the amplifying equipment covered in Alternate G of these specifications. Signal selection means must be suitable for integration with the Audio-Visual control facilities provided by the supplier of Alternate G.

4. The system shall include a minimum of 8 trunk lines from the audio-visual storage area in the Resources Library and a minimum of 10 trunk lines from the control room of the Learning Laboratories in Walter Hall, permitting signals originating in these remote areas to be channeled into the audio distribution system through the Audio Control Center.

5. An audio patch panel or approved equivalent means shall be provided at the Audio Control Center in the Master Control area to make possible the revision of connections between signal sources and the distribution channels. Monitoring instruments shall be provided for checking both the level and quality of signals in each channel. Patch panel connection points (or equivalent access means) shall be provided for all audio lines leading to or from the following areas: both radio studios, the control room of the Learning Laboratories, the Assembly Hall, the Cinema Laboratory and Multi-Purpose Room, and the audio-visual storage area of the Resources Library. In addition, the patch panel shall include terminal facilities for the four audio-pair circuits which accompany the coaxial cables in the video distribution system, for a minimum of two trunk lines to the television master control area, and for a minimum of 16 input channels from signal sources to be located in the Master Control area (some of them in reserve for the future). Provision shall also be made in the Audio Control Center for such Telephone Company terminal facilities as may be required for amplified telephone interviews.

6. Signal sources for the initial installation shall include four single channel continuous-loop cartridge tape players, owned by Stephens College, to be relocated in the Master Control area.

7. The supplier of this alternate shall provide an AM radio tuner, an FM radio tuner (equipped to receive multiplex stereo signals), a short-wave communications receiver covering all bands from 550 kc to 30 mc, and suitable antenna systems for all receivers.

8. Facilities at the Audio Control Center shall include two audio tape recorders capable of recording or reproducing either monaural or stereophonic program materials.

9. As an optional item, each bidder is requested to show the cost of a quantity of 10 small loudspeaker listening units with self-contained amplifiers which might be substituted for earphones at any listening station, providing a nominal output of at least 2 watts with not more than 2% distortion. (Such units will be of great interest to Stephens College when the system is eventually expanded to faculty offices and student dormitory rooms, but a small quantity may be acquired for experimental purposes in the Learning Center, especially in lounge areas.) Where stereophonic listening is required, it is planned to use two identical loudspeaker units.

10. The remote control of mechanical operations for audio playback devices (such as starting, stopping, reversing, etc.) from listening locations is not required, but will be regarded by Stephens College as a significant advantage for systems which can provide this feature.

11. The possibility of intercommunication service between listening locations and the Master Control area via the same transmission lines used for the audio distribution system is not required, but will also be regarded by Stephens College as a significant advantage. Proposals that include economical provision for this function will be welcome.

D. Minimum Performance Requirements

1. The frequency response of the transmission system to any listening point shall be uniform within ± 2 db for all frequencies between 50 and 15,000 cps. Total rms distortion shall not exceed 2% over the same frequency band, and the hum and noise level shall be at least 60 db below rated output.

2. Crosstalk between any two channels in the distribution system shall not exceed -50 db.

3. The frequency response of all earphones supplied under this alternate shall be uniform within ± 3 db from 50 to 10,000 cps. Earphone cushions shall be large enough to bear directly on the head, rather than on the outer ears, both to minimize discomfort during prolonged listening periods and to provide the acoustic seal needed for proper low-frequency response.

4. Each of the audio tape recorders shall operate at tape speeds of 7.5 or 3.75 inches per second, and shall have provision for half-track monaural recording or playback, dual half-track stereo recording or playback, and playback of 4-track pre-recorded stereo tapes. Each recorder shall include at least one VU meter for monitoring record and playback levels; separate VU meters for the two channels are preferred. It must be possible to add remote controls for stop, play, record, fast forward, and reverse functions, although no remote control panel is required under this alternate. Minimum performance specifications at 7.5 ips shall be:

Frequency Response: ± 2 db, 50 to 15,000 cps.
Wow and Flutter: Less than 0.2% rms.
Signal-to-Noise Radio: At least 50 db.

5. All inputs for remote lines from other areas of the Learning Center shall have input impedances of 600 ohms and shall accept signals at any level between -10 and +18 dbm.

E. Minimum Mechanical Requirements

1. The system is to be installed in the same conduit system which serves the coaxial cable

television distribution system. Bids for systems of the FM carrier type intended to utilize the same coaxial cable already installed (or due to be installed) for television distribution may omit the cost of the cable itself; in all other cases, the supplier of this alternate shall provide enough cable of suitable types to complete all cable runs for the initial installation. Provision shall be made for the concealment of all wiring to listening locations in the Resources Library.

2. If the supplier of this alternate receives the contract for installing as well as supplying the facilities specified herein, it shall become his responsibility to determine satisfactory locations on the roof of the TV-Radio-Film-Science Building for the antenna systems required for proper functioning of the radio receivers. The locations chosen shall be subject to approval by Stephens College.

ALTERNATE G

AUDIO-VISUAL EQUIPMENT AND CONTROL FACILITIES

A. Objectives and Brief Description

The facilities specified in this alternate are intended to make it possible to employ audio-visual teaching aids in certain classrooms and other teaching spaces in the Learning Center with a high degree of convenience, efficiency, and effectiveness. Stephens College already owns many types of audio-visual devices in substantial quantities, but the College feels that the new facilities in the Learning Center should provide fresh opportunities to encourage more widespread and systematic use of audio-visual techniques.

Because the equipment required under this alternate is to be used in several different types of teaching spaces, the specifications are subdivided into three separate groups. In the Assembly Hall, Cinema Laboratory, and Multi-Purpose Room, where spaces have been designed specifically for audio-visual presentations, the College intends to install permanent projection equipment and remote control facilities "tailored" specifically to this equipment. Audio facilities for these rooms have been covered in earlier sections of these specifications, and are of such complexity that control would normally be delegated to an audio operator, rather than to an instructor in front of the class. In the case of the smaller lecture rooms and classrooms, however, the systems are simple enough that they would normally be under the complete control of the instructor. For the foreseeable future, the College cannot afford to install permanent facilities for all of the recognized audio-visual media in all spaces where such media might be used from time to time, but the facilities specified here are intended to make possible the rapid installation and convenient operation of portable equipment.

Even though these specifications call for a substantial number of small-scale systems, rather than a single large system, the College expects each bidder to offer a common solution for common problems. That is, the control facilities in the several types of rooms should be basically similar (though detailed requirements may vary somewhat), and a minimum number of equipment designs should be used.

Stephens College recognizes several possible solutions to each of the problems involved in the convenient control of audio-visual equipment, and is willing to give bidders for this alternate considerable freedom in selecting the types of equipment and control facilities which they consider most suitable as components for unified teaching systems. In evaluating the bids for this alternate, however, Stephens College will be keenly aware of the fact that the systems finally selected will, in effect, establish basic audio-visual equipment standards at Stephens for many years into the future and may wish to request substitutions in some instances.

Architectural and wiring details for the audio-visual facilities specified herein are shown on the following drawings: A-2, A-3, A-7, A-25, A-26, A-27, E-1, E-2, E-3, E-4, E-5, E-6, E-7, E-8, E-9, E-10, E-11, RE-1, RE-3. Potential suppliers are encouraged to visit the Stephens campus to develop first-hand knowledge of the requirements and to discuss possible solutions for anticipated problems.

B. Minimum Specifications--Assembly Hall System

1. The supplier of this alternate shall provide three projection screens and arrangements for mounting them in the Assembly Hall stage area in such a manner as to obtain proper projection conditions from the projection room and proper view-conditions from the audience area. Screens shall be nominally 12 by 12 feet in size or 1/6 viewing distance from rear of room. The center and right-hand screens (as seen from the audience) shall be mounted from the stage ceiling, and shall be raised or lowered by remotely-controlled motor drives. The left-hand screen shall be designed for keystone-free projection of images from an overhead projector mounted at the position shown on Drawing No. A-26. A motor-driven means for retracting this screen when not in use is desirable, but if such motor drive proves impractical

(because of the tilt required for an overhead-projector screen), the mounting arrangement shall be such that it is possible for one man to either erect or remove the screen assembly in 10 minutes or less. Beaded, mildew-proof screens are preferred.

2. The system shall include a 16-mm motion-picture projector permanently mounted in the projection room in a proper position for projecting an image to fill the center screen. This projector shall be capable of accepting reels of up to 2,000 feet, and shall have provision for remote control of starting and stopping. Remote control of focus and reverse is considered desirable, but is not required. It shall be possible for an operator in the projection room to override the remote controls when desired. The sound track amplifier shall be equipped with such impedance transformation devices as may be required to deliver an audio signal at a nominal level of +18 dbm across 600 ohms, and the supplier of this alternate shall provide all cable and other facilities needed to connect the projector audio output to the terminals provided for this purpose in the jack field for the Assembly Hall Sound System. Bidder shall indicate light level on screen for system bid.

3. The system shall include two identical projectors for 2 by 2 inch slides, mounted in the projection room in proper positions for projecting images on the center and right-hand screens. These projectors shall be magazine- or cartridge-loading, and shall accept a minimum of 32 slides at one time. It would be preferable to have random access and greater capacity. The projector design must permit remote control of focus, off-on, slide change forward, and slide change reverse. It shall be possible for an operator in the projection room to override the remote controls when required. If the projector design is such

that it is necessary to keep a blower in operation for a minimum period of time after the lamp is turned off to protect either the lamp or the slides, the system shall include arrangements so that the remote "off" control turns off only the lamp, and a time-delay relay or equivalent device shall be used to turn off the blower after an appropriate interval. Bidder shall indicate light level on screen for system bid.

4. The system shall include a projector for 35-mm filmstrips, mounted in the projection room in a location suitable for projection of images on the right-hand screen. The projector design must be suitable for remote control of off-on and "advance" functions. Remote control of reverse and focus is considered desirable but is not required. Bidder shall indicate light level on screen for system bid.

5. Bidder should provide balanced light levels for all projectors.

6. The system shall include a trip-cue unit, capable of accepting tone signals from an audio tape recorder and producing a contact closure suitable for operation of the "slide change" or "advance" function in either of the slide projectors or the filmstrip projector included in the Assembly Hall Audio-Visual System. This unit shall be mounted in the vicinity of the projectors, and shall be equipped with (or accompanied by) a "delegation" switch permitting connection of the unit to the appropriate control leads of any of the three projection devices to be controlled. (An "off" position must also be provided to remove the trip-cue unit from the system when required.) The design must be such that the normal remote control panels for the projection devices continue to operate in all respects (so that a lecturer can override the automatic control if desired). The

tone frequency used may be either very low (below 50 cps) or very high (above 6500 cps), but the design of the trip-cue unit must be such that it will operate satisfactorily either from "clean" tone signals recorded on a separate track of a multi-channel track tape recorder (the preferred operating condition), or from tone signals combined with either speech or music signals (an operating condition that may be necessary when utilizing single-track audio devices or when slides or filmstrips are synchronized with stereophonic audio materials). The audio input for the trip-cue unit shall have an input impedance of 600 ohms, and shall be capable of satisfactory operation when receiving signals corresponding to normal program levels of -10 to ≠18 dbm. (It is recognized that the cue tones themselves may be transmitted at less than full program level to minimize intermodulation problems when combined with program signals.) The unit shall also have an audio output capable of delivering a signal to a 600-ohm load at essentially the same level as the input signal. Between the input and the output, the trip-cue unit shall provide for the optional insertion of a filter or equivalent device capable of attenuating the cue tones to a level not greater than -30 db relative to the peak program signals with minimum disturbance of the adjacent program frequencies. The supplier of this alternate shall provide all cable and other facilities needed to connect the trip-cue unit to terminals provided for this purpose in the jack field of the Assembly Hall Sound System. (It is intended that the trip-cue unit be connected directly to one channel of a dual-track tape recorder when a separate tone channel is available, or connected in series with a tape recorder output channel when the cue tones are combined with program materials.)

7. The supplier of this alternate shall provide two identical trip-cue tone generators packaged in portable cases and designed for use in conjunction with any audio tape recorder to produce signals meeting the requirements of the trip-cue unit specified above. It shall be possible to connect the tone generator directly to the appropriate input of a tape recorder in which a separate track is available for cue-tone purposes, or to connect the generator in series with a normal program input in cases where the tones must be added to program material. A push-button to control the generation of tone signals shall be mounted directly on the tone generator, and there shall also be suitable terminals for remote control through any simple contact closure. (It is intended that these portable tone generators be used in association with recorders located anywhere in the Learning Center whenever it is desired to produce audio programs with provision for automatically-synchronized still-picture displays.

8. The system shall include a signaling circuit enabling a lecturer in the Assembly Hall to attract the attention of an operator in the projection room. Within the projection room, there shall be a selection switch permitting the signaling circuit to be connected either to a buzzer, a prominent red light on the projection-room wall, or to both devices simultaneously. An additional position on the selection switch shall make it possible to connect the signaling circuit to the input of a trip-cue generator.

9. The system shall include a lectern with built-in remote controls for the audio-visual equipment. Provision shall be made for the convenient movement of the lectern to right-stage, center-stage, or left-stage locations near the outlet boxes provided for the audio-visual control

system; connections to the projection equipment shall be made through a minimum number of plug-in connectors. The lectern shall have a built-in reading light with convenient off-on and dimming or step control and a suitable mounting surface for a microphone. (The microphone itself and the connection to the Assembly Hall Sound System is not a part of this alternate.) Controls provided at the lectern shall include:

(a) Up-down controls for all motor-driven screens.

(b) Dimmer controls for two independent room-lighting circuits (normally connected to audience lighting and stage lighting circuits). It shall be the responsibility of the supplier for this alternate to determine from the electrical contractor the specific requirements for the lighting control devices.

(c) Start-stop controls for the 16-mm film projector (plus remote focus, if provided in the projector).

(d) Start-stop controls for the audio tape recorder provided under Alternate A of these specifications (playback function only).

(e) Off-on and advance controls for the film-strip projector (plus remote focus and reverse, if provided in the projector).

(f) Off-on, focus, slide change forward, and slide change reverse controls for each of the two slide projectors.

(g) A pushbutton to actuate the signaling circuit to the projection room.

(h) A slide-change button on the end of a 25-foot flexible cord (for the convenience of lecturers who prefer to move about while lecturing). There shall be provision for connecting this cord and button (by means of multiple plug-in connectors or a delegation switch) to the "slide change forward" control leads for either of the two slide projectors, to the "advance" control leads for the filmstrip projector, or to the signaling circuit. The lectern shall include a convenient means for storing the cord when not in use.

(i) Telephone with signal light in place of audible signal for amplified telephone and service calls through switchboard.

10. The system shall include an overhead projector for 10 by 10 inch transparencies, mounted in a desk roughly equal in size and compatible in design with the lectern so that the two units may be operated adjacent to each other in the location shown in Drawing No. A-26. The projector shall be mounted at the proper angle to eliminate keystoning of the image on the left-hand projection screen specified in Item 1, with the projection aperture at a nominal working height of 40 inches. The projector desk shall include convenient surfaces for holding transparencies both before and after use, and convenient bins or drawers for storing supplies normally associated with the projector (including spare bulbs, grease pencils, and polarizing attachments). The projector shall be equipped with facilities for the convenient movement of a continuous roll of Cellophane (or equivalent material) across the projection aperture, and off-on controls shall be readily accessible to the lecturer.

11. The system shall include provision for television projection, remote on-off control at lectern desirable.

12. The supplier of this alternate shall be responsible for providing all cables and connectors required for interconnections between all

components of the audio-visual system and between the audio-visual system and the Assembly Hall Sound System. Wiring in the conduits between the projection room and the three alternative plug-in connection points for the lectern shall include a minimum of 12 spare conductors for future audio and/or selection use.

C. Minimum Specifications--Cinema Lab and Multi-Purpose Room System

1. The supplier of this alternate shall provide six beaded, mildew-proof projection screens for this sub-system, all of them nominally 8 feet square or 1/6 viewing distance from rear of room, Arrangements shall be provided for mounting three of these screens in the Cinema Laboratory in positions which provide proper projection conditions and proper visibility from the audience area. The center and right-hand screens, as seen from the audience area, shall be of manually-controlled, roll-up type. The left-hand screen shall be mounted in the proper tilted position for projection of keystone-free images from an overhead projector. The mounting arrangement for the overhead-projector screen shall be such that it is possible for one man to erect or remove the screen assembly in 10 minutes or less. Two additional screens of the manually-controlled roll-up type shall be mounted at the front of the Multi-Purpose Room in locations indicated on drawing No. A-7. A tilted overhead-projector screen with retractable ceiling poles or some equivalent mounting means shall be provided for optional use in either half of the Multi-Purpose Room. It shall be possible to erect or remove this screen in 10 minutes or less.

2. The system shall include two 16-mm motion-picture projectors with multiplexing arrangements that permit either projector to

project images upon any of the four roll-up screens in the system. The multi-plexing arrangement might consist of movable mirrors, tracks for changing the projector locations, or several sets of permanently-installed mounting plates permitting rapid and secure placement of the projectors in several alternative locations. Each projector shall be capable of accepting reels of up to 2,000 feet, and shall have provision for remote control of starting and stopping. Remote control of focus is considered desirable, but is not required. It shall be possible for an operator in the projection room to override the remote controls when desired, and to delegate control of each projector to the desired lectern position. (Multiple plug-in connectors will be accepted as a suitable delegation means.) The sound track amplifiers shall be equipped with such impedance transformation devices as may be required to deliver audio signals at a nominal level of ≠18 dbm across 600 ohms, and the supplier of this alternate shall provide all cable and other facilities needed to connect the projector audio outputs to the terminals provided for this purpose in the jack field of the sound system serving these rooms.

3. The system shall include two identical projectors for 2 by 2 inch slides, with multiplexing arrangements permitting either of these projectors to project images on any of the four roll-up screens. With the possible exception of the focal length of the projection lenses, the slide projectors provided for this sub-system shall be identical to those provided for the Assembly Hall System, with interchangeable lenses and with the same provision for remote controls. Provision shall be made for delegating remote control functions for each projector to the appropriate lectern positions.

4. The system shall include two projectors for 35-mm filmstrips, identical to those provided for the Assembly Hall System, with the possible exception of the focal length of the projection lenses. Lenses should be interchangeable. Multiplexing arrangements shall be provided to permit either projector to project images on any of the four roll-up screens, and provision shall be made for delegating remote control functions for each projector to the appropriate lectern positions.

5. Bidder should provide balanced light levels for all projectors.

6. The system shall include a trip-cue unit, identical in performance characteristics to the one specified for the Assembly Hall System. The delegation switch (or equivalent facility) associated with this unit shall permit its connection to either of the slide projectors or either of the filmstrip projectors. The supplier of this alternate shall be responsible for providing all cable and other facilities needed to connect the audio input and output circuits of the trip-cue unit to terminals provided for this purpose in the jack field of the Sound System serving these rooms.

7. The system shall include three independent signaling circuits, enabling lecturers in the Cinema Laboratory or either half of the Multi-Purpose Room to attract the attention of an operator in the projection room. For each such circuit, there shall be a selection switch in the projection room permitting the circuit to be connected to a buzzer, to a prominent red light on the projection-room wall, or to both devices simultaneously. An additional position on each selection switch shall make it possible to connect the signaling circuit to the input of a trip-cue tone generator.

8. The system shall include two television receivers of not less than 23-inch nominal picture diagonal permanently installed in the two half-sections of the Multi-Purpose Room. The receivers shall be suspended from the walls or ceilings in yoke-type mounts that permit pan and tilt movement to achieve the most favorable viewing conditions for several different audience seating arrangements. Receivers shall be serviced, mounted and removed with minimum difficulty. The receiver design shall permit remote control of off-on, channel selection, fine tuning, sound volume, contrast, and brightness. Remote-control connections shall be made through suitable plug-in connectors and concealed wiring to the lectern closest to each receiver. The audio output from each receiver shall be connected to the terminals provided for this purpose at the jack field of the sound system for the Multi-Purpose Room, and shall include such matching devices as may be required to deliver a signal at a level of nominally ≠ 18 dbm across 600 ohms when the remote volume control is set at approximately 2/3 full setting. The television receivers shall have glare-resistant faceplates, full dc restoration, and i-f bandwidths of not less than 3.5 mc at the 6 db. point. Raster stability shall be such that the overscan does not remove more than 5% of the picture area at any edge for power line voltage variations between 105 and 125 volts.

9. The system shall include a lectern for the Cinema Laboratory with the same facilities as those provided for the Assembly Hall lectern, with the exception that controls for the motor-driven screens may be omitted. Provision shall be made for the convenient movement of this lectern to positions at either side of the stage area or to a position adjacent to the overhead-projector location.

10. The system shall include two identical

lecterns for the two half-sections of the Multi-Purpose Room. Each lectern shall be connected to the outlet box for the audio-visual control circuits through a minimum number of plug-in connectors and nominally 20 feet of flexible cable to allow reasonable freedom in locating the lectern in optimum positions for various types of programs; the lectern shall include provision for accommodating the excess length of cable in some convenient manner, such as cleats mounted in a concealed location. In addition to a built-in reading lamp with convenient off-on and dimming or step control and a suitable mounting surface for a microphone, each lectern shall include the following control facilities:

(a) A four-position switch providing for three levels of lighting in the appropriate section of the Multi-Purpose Room, plus an "off" position. Through a separate switch, or through additional positions on the same switch, it shall be possible to control the lighting for both halves of the room from either lectern position. It shall be the responsibility of the supplier of this alternate to determine from the electrical contractor the specific requirements for the lighting control devices.

(b) Off-on, channel selection, fine tuning, contrast, brightness, and sound volume controls for the television receiver closest to the lectern.

(c) Start-stop reverse controls for a 16-mm projector (plus remote focus, if provided in the projector).

(d) Off-on, focus, slide change forward (or "advance"), and slide change reverse controls for two independent still-picture projectors. (When connected to a filmstrip projector, only the off-on and advance, reverse if available, controls may be operative.)

(e) A pushbutton to actuate the signaling circuit to the projection room.

(f) A slide-change button on the end of a 25-foot flexible cord, with provision for connecting this cord and button to either of the still-picture "advance" or "slide change forward" circuits or to the signaling circuit. The lectern shall include a convenient means for storing the cord when not in use.

(g) Telephone for amplified calls and switchboard access.

(h) Speaker timing device.

11. The system shall include two overhead projectors mounted in desks providing the same facilities previously described for the Assembly Hall System. The mounting desks shall be compatible in design with the lecterns supplied for this sub-system, so that the overhead projectors can be operated conveniently from positions adjacent to any of the lecterns. The mounting desks shall be equipped with casters or equivalent means for moving them readily from one location to another, and must be small enough to pass readily through 3-foot doorways. Provision shall be made for locking the casters or otherwise stabilizing the position of the mounting desks when the overhead projectors are in use.

12. The supplier of this alternate shall be responsible for providing all cables, connectors, and matching devices required for interconnections between all components of this system and between this system and the sound system serving the same areas. Wiring in the conduits between the projection room and the several plug-in connection points for lecterns shall include a minimum of 12 spare conductors for future audio and/or selection use.

D. Minimum Specifications--Classrooms Systems

1. These specifications apply to facilities to be installed in each of the following rooms:

Building A:	Science Lecture Room (A210)
Building B:	Humanities Classrooms (B105, B106, B107, B120, B121, B122, B123) Communication Classrooms (B210, B211, B222, B223, B224, B225)
Building C:	Classroom (C101)

All systems shall be nominally identical, but with such minor adaptations as may be required to accommodate architectural differences in the several rooms.

2. Each system shall include a television receiver meeting the same minimum specifications as those cited above for the Multi-Purpose Room System, including the same provision for remote controls and for mounting from wall or ceiling. See architectural drawing No. A-25 for location of mount.

3. Each system shall include a permanently-installed beaded projection screen of the ceiling-mounted, roll-up type (manually-operated), located in such a position that it shall be possible to place a second vertical screen or an overhead projection screen in the same room without blocking the view of the permanently-installed screen. Screen shall have a dust cover shell. The nominal width of each screen shall be approximately equal to 1/6 of the maximum viewing distance at the back of the room.

4. Each system shall include a pair of permanently-installed loudspeaker systems mounted

at the front of the room in suitable locations for the reproduction of either stereophonic or monaural program materials. Bidder should check architectural drawings for size and location of speaker openings and for shape and size of rooms to determine proper power output needed. The crossover frequency for each of these loudspeaker systems shall be not higher than 500 cps, and the high-frequency radiators shall be highly directional, providing a distribution angle of nominally 60 degrees.

NOTE: The reason for this directional requirement is that each classroom is a potential originating point for amplified-telephone conversations. Because of the limited low-frequency response of typical telephone circuits, the great majority of the energy in telephone signals is contained in the band above 500 cps. Through the use of a directional speaker system, it becomes feasible to place an open microphone of a highly directional type in a location outside the "pattern" of the loudspeaker to pick up voices from the class, permitting highly natural conversations without the "push-to-talk" switches that would normally be required to avoid acoustical feedback. It is intended that broadcast-type microphones and remote amplifiers be moved into front of classrooms when amplified telephone interviews are scheduled, and connected to the Audio Center in Master Control through audio pairs provided for this purpose in the main distribution system. The incoming telephone signal would be received in the classroom (or in as many classrooms as desired) through an assigned channel in the audio distribution system. If this system is appreciably more expensive than a "push-to-talk" system, the latter would be preferred. Voice activated relay will also be considered.

5. Each system shall include a dual-channel audio amplifier properly matched to the loudspeakers and with adequate power output to distribute sound throughout the room under normal audience conditions. Frequency response of each amplifier channel shall be uniform ± 1 db from 50 to 15,000 cps, distortion shall not exceed 2% at rated output, and the hum and noise level shall be at least 70 db below rated output. The amplifier shall be mounted in an adequately-ventilated housing incorporated in the audio-visual control panel described below, with provision for convenient accessibility for servicing.

6. Each system shall include a wall-mounted audio-visual control panel at a point adjacent to the instructor's desk, providing the following minimum functions:

(a) Master AC switch for all audio-visual equipment.
(b) A four-position switch providing for three levels of room lighting plus an "off" position. It shall be the responsibility of the supplier of this alternate to determine from the electrical contractor the specific requirements for the lighting control switch.
(c) A dual volume control for the two channels of the audio amplifier, enabling the sound level of the two channels to be adjusted either simultaneously or independently.
(d) Dual bass and treble tone controls for the two channels of the audio amplifier.

(e) An input selector switch for the audio amplifier, providing a choice of: (1) the output of the television receiver, (2) the output of the soundtrack amplifier of a motion-picture projector, (3) the output of a mobile audio-visual console (described below) which may be plugged into the audio-visual control panel, or (4) the output of a channel selector connected to the main audio distribution system for the Learning Center. For maximum intelligibility, all monaural signal sources shall be connected to one channel only of the stereo sound system; TV sound shall be distributed from the loudspeaker closest to the TV receiver.

(f) A channel selector for the audio distribution system supplied under Alternate F of these specifications. It shall be the responsibility of the supplier of this alternate to determine from the successful bidder for Alternate F the specific requirements for this channel selection device.

(g) Off-on, channel selection, fine tuning, contrast, brightness, and sound volume (or sound volume preset) controls for the television receiver.

(h) Start-stop reverse controls for a 16-mm projector.

(i) Off-on, focus, slide change forward (or "advance"), and slide change reverse controls for two independent still-picture projectors. (When used with filmstrip projectors, only the off-on and advance, plus reverse if available, controls may be operative.)

(j) A slide-change button on the end of a 25-foot flexible cord, with provision for connecting this cord to either of the still-picture "advance" control circuits. The audio-visual control panel shall include a storage compartment for this cord when not in use.

(k) A minimum number of plug-in connectors for completing circuit connections to the mobile audio-visual console described later in these specifications.

7. Each system shall include a projector connection panel at the rear of the room (the conduit is already provided) with provision for connecting a 16-mm projector and two still-picture projectors (which may consist of two slide projectors, two filmstrip projectors, or one of each). All connections required for power, remote control, and audio output shall be provided through this panel, utilizing a minimum number of plug-in connectors.

8. The supplier for this alternate shall provide six mobile audio-visual teaching consoles suitable for use in any of the classrooms equipped with audio-visual control panels. In addition to a working surface for a seated instructor, the mobile audio-visual console shall include:

(a) A record player for the reproduction of either monaural or stereophonic recordings of up to 12 inches in diameter at 33 1/3 RPM.

(b) An audio tape recorder suitable for the reproduction of half-track monaural recordings, dual-track stereo recordings, four-track stereo recordings, and dual-channel recordings in which one channel is utilized for cue tones for the automatic operation of slide or filmstrip projectors. It is anticipated that the tape recorder will be used only infrequently for recording.

(c) A trip-cue unit with performance characteristics identical to the one specified for the Assembly Hall System.

(d) Switches and control facilities required for the convenient operation of the devices mounted in the audio-visual console, to select the desired output signal or combination of output signals for transmission through the audio-visual control panel to the audio amplifiers and loudspeakers, and to connect the trip-cue unit to the "advance" control circuits of either of the still-picture projectors which may be connected through the Projector Connection Panel and the audio-visual control panel.

(e) Closed storage spaces for accessories and supplies normally associated with the equipment, such as tape recorder microphones, empty reels, additional reels of tape, records, etc.

(f) An auxiliary input channel for additional tape recorder or record player.

The mobile audio-visual teaching consoles shall be mounted on casters 5" in diameter, soft rubber, ball-bearing, swiveling, with locks on 2 wheels to permit easy movement from one classroom to another, and shall be so constructed as to pass readily through the classroom doors.

9. The supplier of this alternate shall provide six overhead projectors mounted in console units which are compatible with the design of the audio-visual teaching consoles previously described, so that the units can be placed together to form a well-integrated teaching desk with proper ventilation. (The overhead-projector consoles must also be suitable for independent use in rooms with no audio-visual teaching console.) Provision shall be made for the convenient movement of a roll of Cellophane (or equivalent material) over the projector aperture, which shall be mounted at a working height suitable for use by a seated instructor. The console shall include

additional working surfaces for the storage of transparencies before and after use, and for the storage of accessory equipment and supplies. As companion units to the overhead-projector consoles, the supplier of this alternate shall provide 6 portable screens (nominally 70 x 70") with retractable ceiling poles or equivalent means for mounting the screens in the proper tilted position. The combination of the console unit and the screen assembly must make possible the projection of keystone-free images in any of the classrooms.

10. The supplier of this alternate shall provide six optical sound 16-mm motion-picture projectors, equipped with plug-in connectors compatible with those provided on the Projector Connection Panels, and mounted on wheeled stands suitable for rapid placement in any classroom with the facilities specified herein. The stand shall include storage compartments for spare reels, spare bulbs, and other accessories normally associated with projector operation. The sound track amplifier shall be equipped with such matching devices as may be required to deliver audio signals compatible with the input requirements of the audio amplifier incorporated in the audio-visual control panels.

11. The supplier of this alternate shall provide six projectors for 2 by 2 inch slides and six projectors for 35-mm filmstrips, identical in basic design to those provided for the Assembly Hall and Cinema Laboratory systems, and equipped with plug-in connectors compatible with those provided on the Projector Connection Panel. Each projector shall be supplied with a wheeled stand suitable for holding two projectors (the second one to be added in the future, in each case) at a suitable height for rapid placement in any classroom with the facilities specified herein. Each stand shall be equipped with storage compartments for additional filmstrips, spare cartridges or

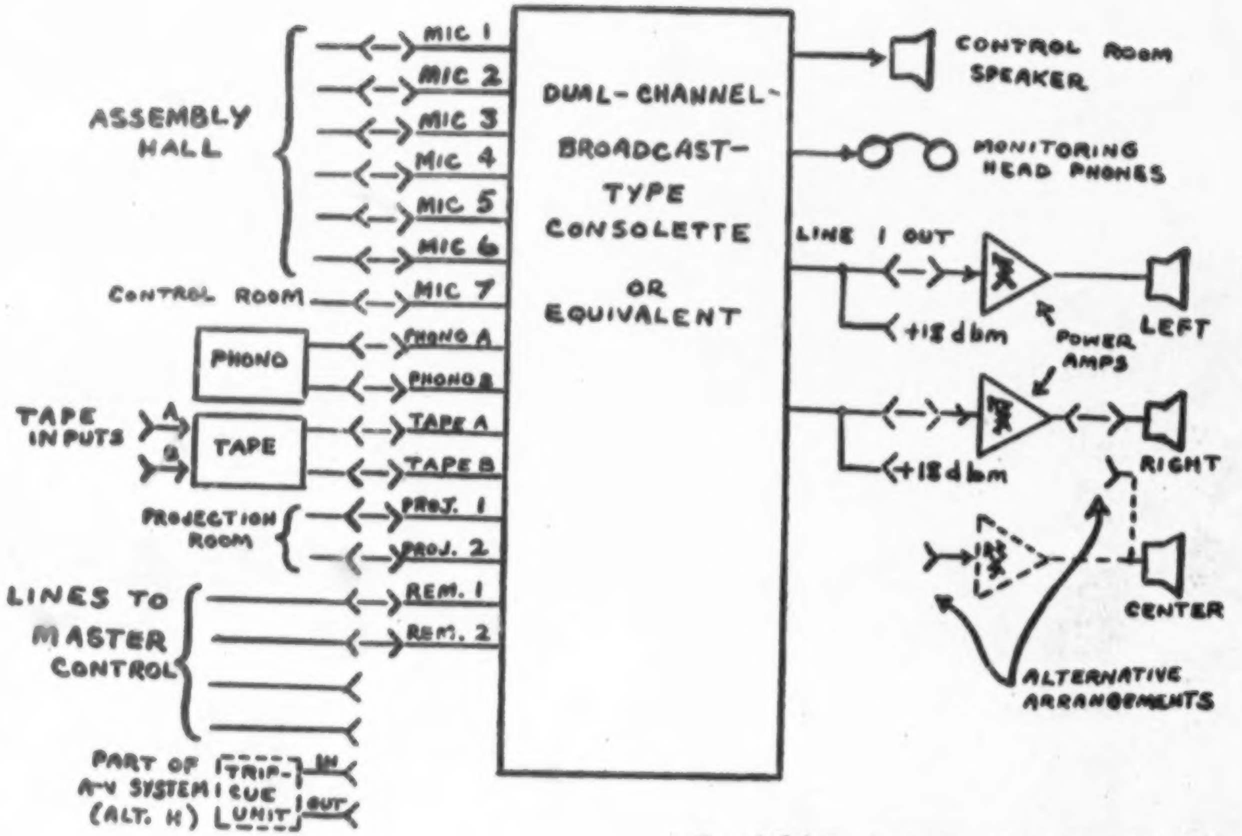
magazines, spare bulbs, and other accessories that may be required for projector operation.

12. The supplier of this alternate shall be responsible for providing all cables, connectors, matching devices, and other components required for all interconnections within the classroom audio-visual system. Wiring in the conduits between the audio-visual control panels and the projector connection panels shall include a minimum of 12 spare conductors for future use.

E. Minimum Performance Requirements

1. Stephens College will expect bidders for this alternate to supply the data required to perform a realistic analysis of the quality of the components proposed for use in the audio-visual systems specified herein. Among the firm specifications each bidder will be expected to provide are the following:

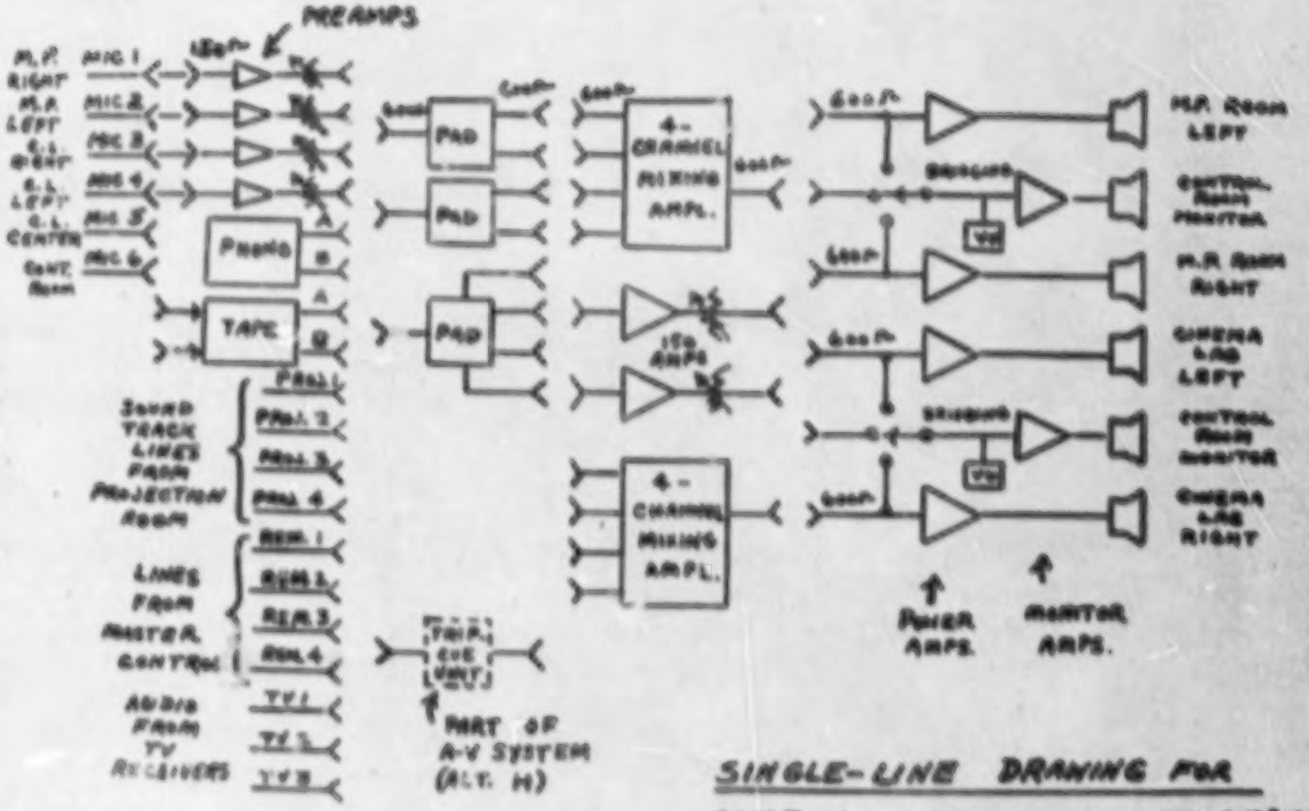
- (a) For all audio devices: frequency response, distortion, hum and noise level, wow and flutter.
- (b) For projection devices: maximum screen luminance under required projection conditions, resolution at both center and corners of image area, uniformity of illumination across screen area, maximum temperature of slides, film, or transparencies, jump and weave (for motion pictures), slide change interval, maximum acoustic noise level at a distance of five feet from projector.
- (c) Underwriters approval for all equipment.


ASSEMBLY HALL
MIC 1
MIC 2
MIC 3
MIC 4
MIC 5
MIC 6
CONTROL ROOM
MIC 7
PHONO
PHONO A
PHONO B
TAPE INPUTS
A
B
TAPE
TAPE A
TAPE B
PROJECTION ROOM
PROJ. 1
PROJ. 2
LINES TO MASTER CONTROL
REM. 1
REM. 2
PART OF A-V SYSTEM (ALT. H)
TRIP-CUE UNIT
IN
OUT
DUAL-CHANNEL-BROADCAST-TYPE CONSOLETTE OR EQUIVALENT
CONTROL ROOM SPEAKER
MONITORING HEAD PHONES
LINE 1 OUT
+18 dbm
+18 dbm
POWER AMPS
LEFT
RIGHT
CENTER
ALTERNATIVE ARRANGEMENTS

SINGLE-LINE DRAWING

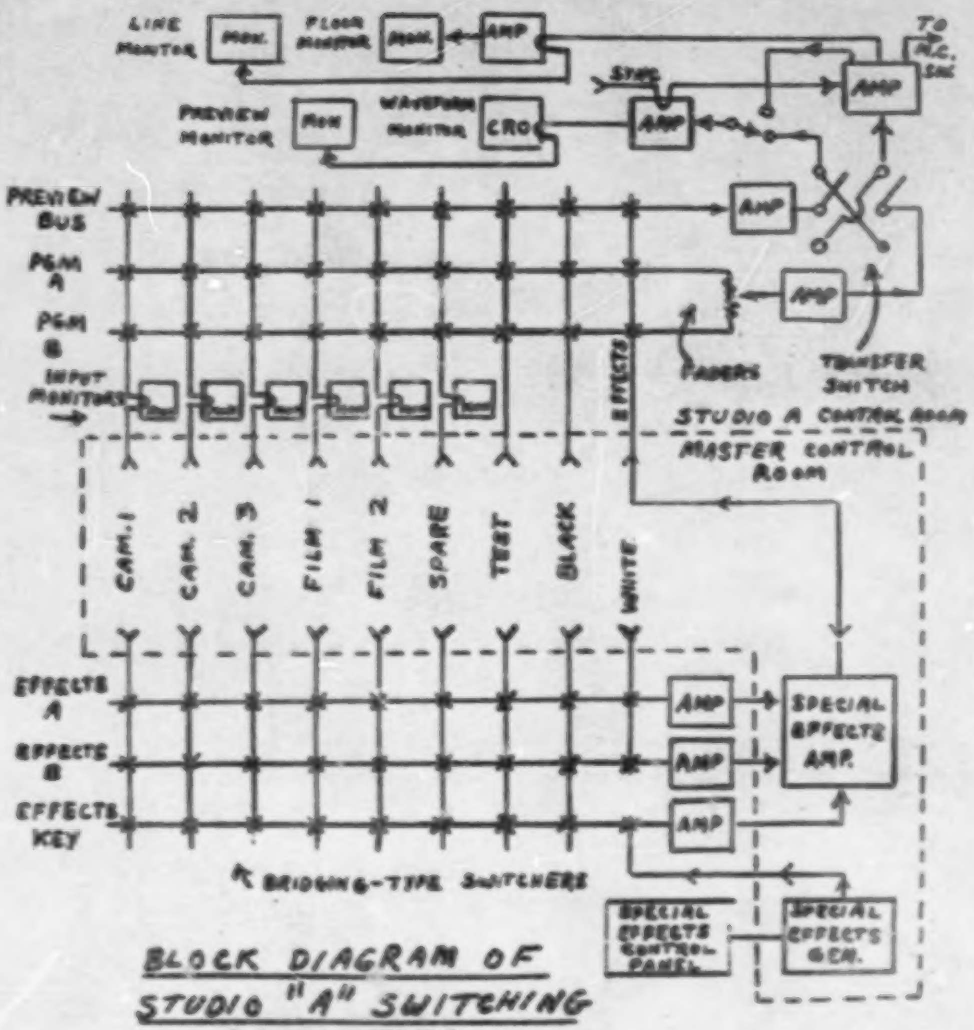
ASSEMBLY HALL SOUND SYSTEM

W-1


PREAMPS
150Ω
M.P. RIGHT
MIC 1
M.P. LEFT
MIC 2
C.L. RIGHT
MIC 3
C.L. LEFT
MIC 4
C.L. CENTER
MIC 5
CONT. ROOM
MIC 6
PHONO
A
B
TAPE
A
B
SOUND TRACK LINES FROM PROJECTION ROOM
PROJ. 1
PROJ. 2
PROJ. 3
PROJ. 4
LINES FROM MASTER CONTROL
REM. 1
REM. 2
REM. 3
REM. 4
AUDIO FROM TV RECEIVERS
TV 1
TV 2
TV 3
600Ω
PAD
PAD
PAD
TRIP. CUE UNIT
PART OF A-V SYSTEM (ALT. H)
4-CHANNEL MIXING AMPL.
4-CHANNEL MIXING AMPL.
ISO. AMPS
600Ω
BRIDGING
VU
POWER AMPS.
MONITOR AMPS.
M.P. ROOM LEFT
CONTROL ROOM MONITOR
M.P. ROOM RIGHT
CINEMA LAB LEFT
CONTROL ROOM MONITOR
CINEMA LAB RIGHT

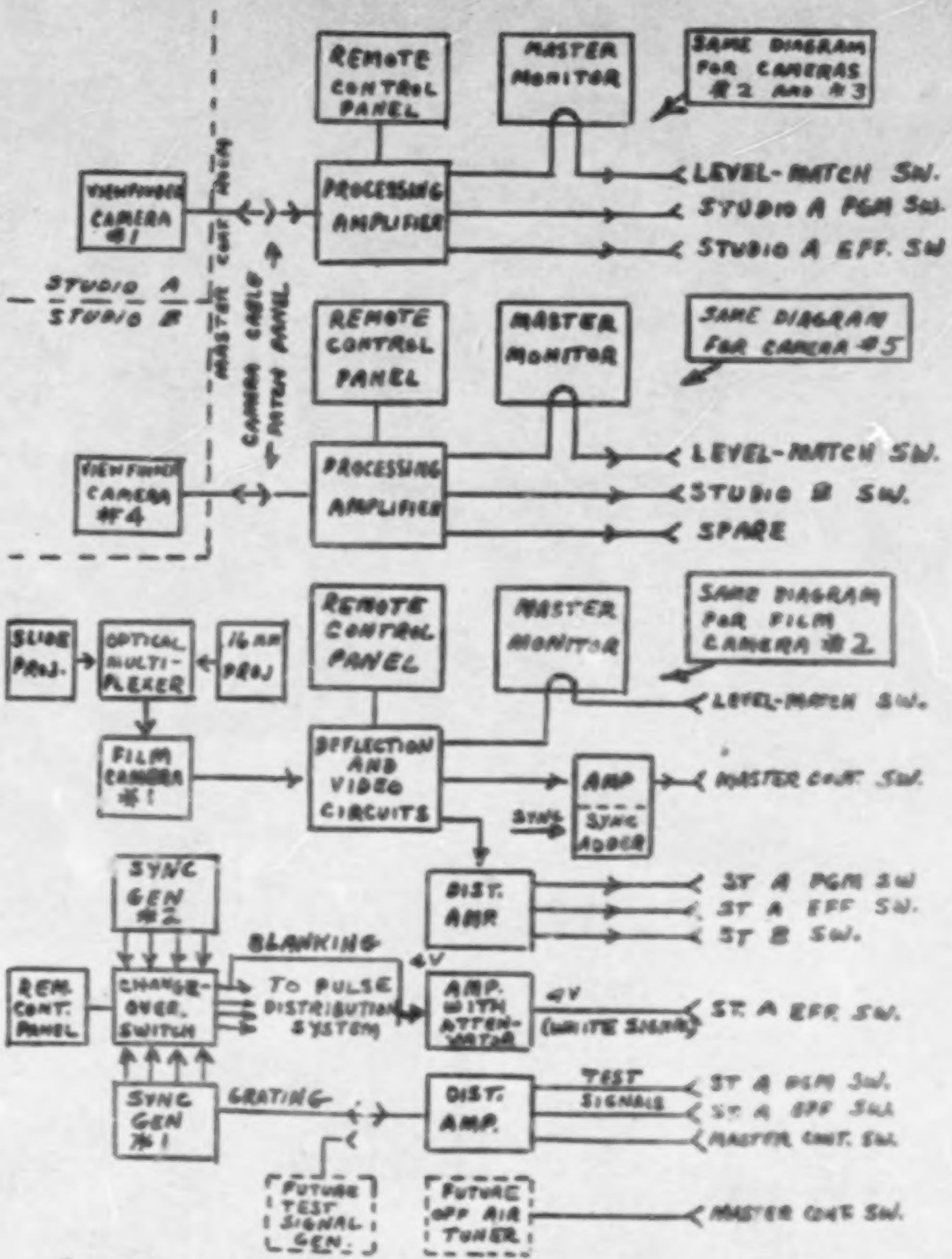
SINGLE-LINE DRAWING FOR
CINEMA LAB AND MULTI-PURPOSE
ROOM SOUND SYSTEM

W-2


LINE MONITOR
MON.
FLOOR MONITOR
MON.
AMP
TO M.C. SW.
SYNC
AMP
PREVIEW MONITOR
MON
WAVEFORM MONITOR
CRO
AMP
PREVIEW BUS
PGM A
PGM B
INPUT MONITORS
AMP
AMP
FADERS
TRANSFER SWITCH
EFFECTS
STUDIO A CONTROL ROOM
MASTER CONTROL ROOM
CAM. 1
CAM. 2
CAM. 3
FILM 1
FILM 2
SPARE
TEST
BLACK
WHITE
EFFECTS A
EFFECTS B
EFFECTS KEY
AMP
AMP
AMP
SPECIAL EFFECTS AMP.
BRIDGING-TYPE SWITCHERS
SPECIAL EFFECTS CONTROL PANEL
SPECIAL EFFECTS GEN.

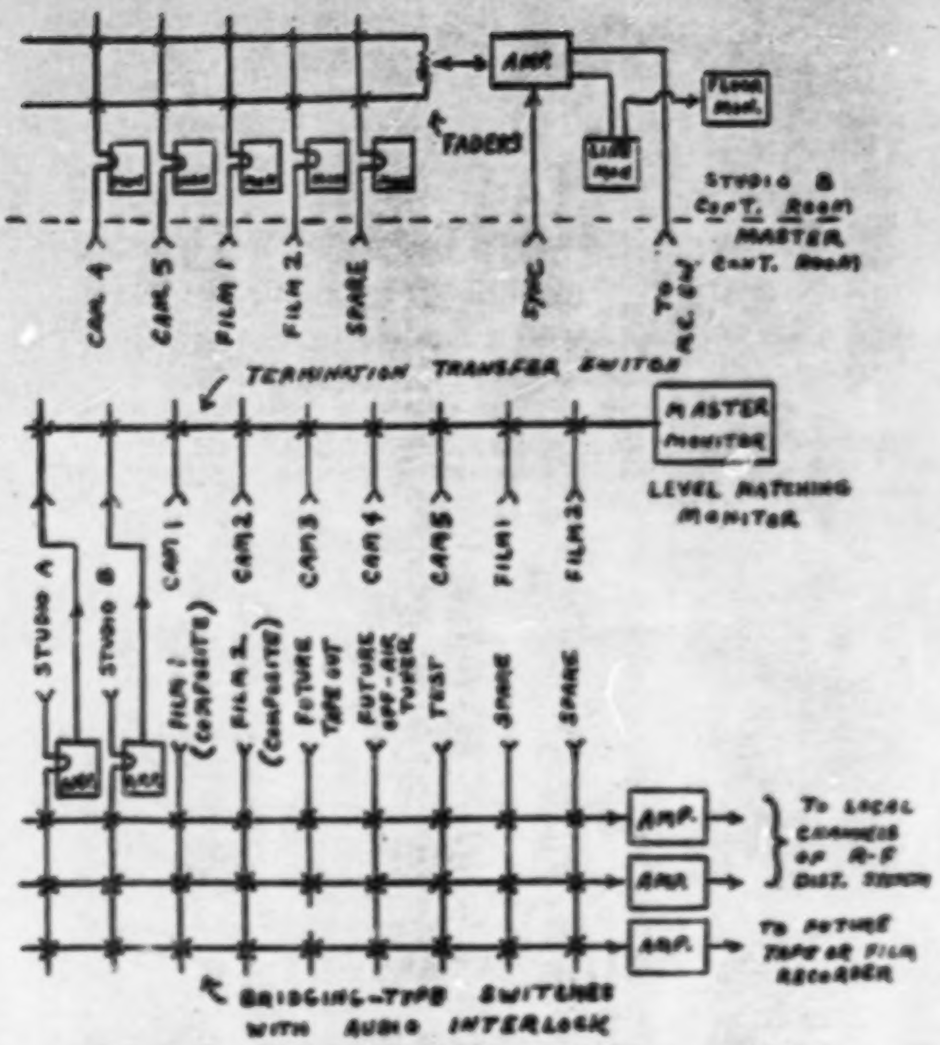
BLOCK DIAGRAM OF STUDIO "A" SWITCHING FACILITIES

W-3


REMOTE CONTROL PANEL
MASTER MONITOR
SAME DIAGRAM FOR CAMERAS #2 AND #3
VIEWFINDER CAMERA #1
MASTER CONT ROOM
PROCESSING AMPLIFIER
LEVEL-MATCH SW.
STUDIO A PGM SW.
STUDIO A EFF. SW
STUDIO A
STUDIO B
CAMERA CABLE PATCH PANEL
REMOTE CONTROL PANEL
MASTER MONITOR
SAME DIAGRAM FOR CAMERA #5
VIEWFINDER CAMERA #4
PROCESSING AMPLIFIER
LEVEL-MATCH SW.
STUDIO B SW.
SPARE
SLIDE PROJ.
OPTICAL MULTI-PLEXER
16 MM PROJ
REMOTE CONTROL PANEL
MASTER MONITOR
SAME DIAGRAM FOR FILM CAMERA #2
LEVEL-MATCH SW.
FILM CAMERA #1
DEFLECTION AND VIDEO CIRCUITS
AMP
SYNC
SYNC ADDER
MASTER CONT. SW.
SYNC GEN #2
DIST. AMP
ST A PGM SW
ST A EFF SW.
ST B SW.
BLANKING
4V
REM. CONT. PANEL
CHANGE-OVER. SWITCH
TO PULSE DISTRIBUTION SYSTEM
AMP. WITH ATTEN-UATOR
4V
(WHITE SIGNAL)
ST. A EFF. SW.
SYNC GEN #1
GRATING
DIST. AMP.
TEST SIGNALS
ST A PGM SW.
ST. A EFF SW.
MASTER CONT. SW.
FUTURE TEST SIGNAL GEN.
FUTURE OFF AIR TUNER
MASTER CONT. SW.

BLOCK DIAGRAM OF VIDEO SIGNAL SOURCES

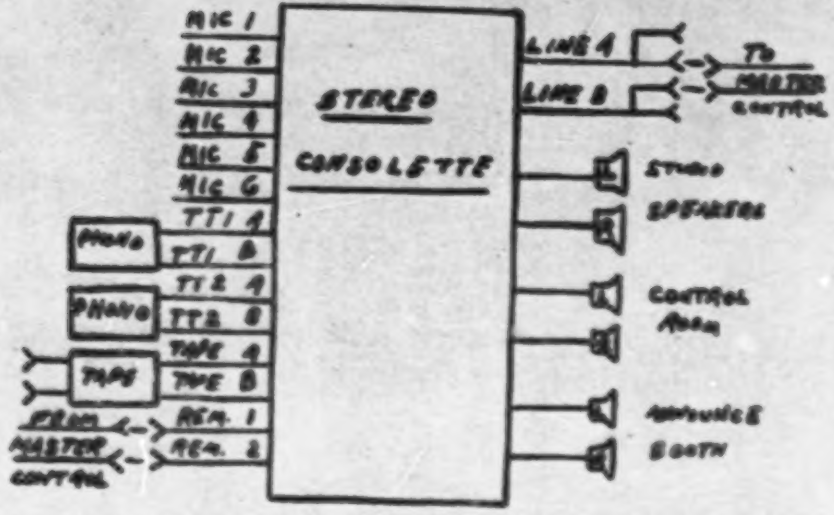
W-4

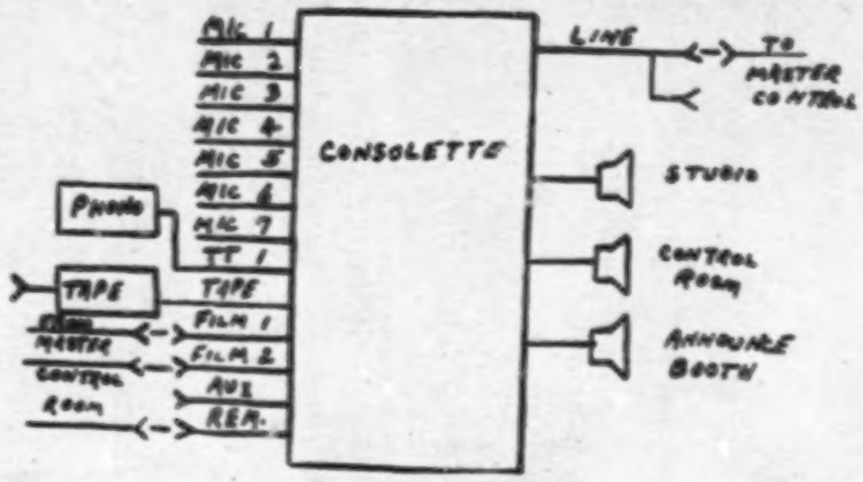

AMP.
FLOOR MON.
LINE MON.
FADERS
STUDIO B CONT. ROOM
MASTER CONT. ROOM
CAM. 4
CAM. 5
FILM 1
FILM 2
SPARE
SYNC
TO M.C. SW.
TERMINATION TRANSFER SWITCH
MASTER MONITOR
LEVEL MATCHING MONITOR
STUDIO A
STUDIO B
CAM 1
CAM 2
CAM 3
CAM 4
CAM 5
FILM 1
FILM 2
FILM 1 (COMPOSITE)
FILM 2 (COMPOSITE)
FUTURE TAPE OUT
FUTURE OFF-AIR TUNER
TEST
SPARE
SPARE
AMP.
AMP.
AMP.
TO LOCAL CHANNELS OF R-F DIST. SYSTEM
TO FUTURE TAPE OR FILM RECORDER
BRIDGING-TYPE SWITCHES WITH AUDIO INTERLOCK

BLOCK DIAGRAM OF SWITCHING FACILITIES FOR STUDIO B AND MASTER CONTROL

W-5

W-6 SINGLE-LINE DRAWING FOR RADIO STUDIO SYSTEM


MIC 1
MIC 2
MIC 3
MIC 4
MIC 5
MIC 6
TT1 A
TT1 B
TT2 A
TT2 B
TAPE A
TAPE B
REM. 1
REM. 2
PHONO
PHONO
TAPE
FROM MASTER CONTROL
STEREO CONSOLETTE
LINE A
LINE B
TO MASTER CONTROL
STUDIO SPEAKERS
CONTROL ROOM
ANNOUNCE BOOTH


MIC 1
MIC 2
MIC 3
MIC 4
MIC 5
MIC 6
MIC 7
TT 1
TAPE
FILM 1
FILM 2
AUX
REM.
PHONO
TAPE
FROM MASTER CONTROL
CONTROL ROOM
CONSOLETTE
LINE
TO MASTER CONTROL
STUDIO
CONTROL ROOM
ANNOUNCE BOOTH

W-7 SINGLE-LINE DRAWING FOR TV STUDIO AUDIO SYSTEM

SPECIFICATION FOR COAXIAL CABLE DISTRIBUTION SYSTEM
FOR THE JAMES M. WOOD LEARNING CENTER
STEPHENS COLLEGE, COLUMBIA, MISSOURI

A. Objectives and Brief Description of Proposed System

The distribution system specified herein is intended to make possible the distribution of both audio and video signals from the Master Control Room to classrooms and other receiving locations throughout the James M. Wood Learning Center as shown on the following drawing: RE-3.

The system is intended to be flexible enough to satisfy both immediate and anticipated future needs. To satisfy a known immediate need, the system shall include a so-called "master antenna" coaxial cable network with associated amplifiers to distribute both television signals (through conventional broadcast channels) and frequency-modulated sound signals (within the conventional FM broadcast band) to all receiver outlets shown on the drawings. (Terminal facilities to introduce FM radio signals are covered in a separate specification.) A second, independent coaxial cable circuit is specified to be run in parallel with the "master antenna" circuit for possible future use in a variety of applications, including direct video feed. No amplifiers are specified for the initial installation of this second coaxial circuit, but it is intended that connections be completed within all junction boxes and outlet boxes in the system in such a manner that the configuration of this second coaxial circuit can be altered readily for such future needs as independent circuits for each floor of a given building, transmission of special signals from any outlet point back to the Master Control Room, or transmission of additional television or FM channels to specific areas. These specifications also require that four shielded audio pairs be run in parallel with the coaxial circuits for possible future use as program sound, control, or intercommunication circuits.

B. Qualified Manufacturers

All basic electronic components of the system described herein shall be the products of a single manufacturer who shall have produced similar apparatus for at least three years. Manufacturers known to meet these requirements include: Jerrold Electronics Corporation, Spencer-Kennedy Laboratories, Radio Corporation of America, and Blonder Tongue. A bidder who proposes to use the products of any other company must supply complete descriptive literature about the manufacturer proposed and a list of installations completed by said company within the past three years. Equipment shall be supplied and serviced through the manufacturer's authorized distributor.

C. Basic System Functions

The distribution system shall include but not be limited to the following minimum functions:

1. The basic distribution network shall consist of the parallel combination of two independent coaxial cable circuits and at least four independent, separately-shielded audio pairs. Each audio pair shall be identified by a separate color code or equivalent means.

2. Each outlet box in the distribution system shall provide means for:

(a) Connecting either a television or FM receiver to the "master antenna" coaxial cable system through a suitable isolation network supplied by the contractor.

(b) Gaining access to the second coaxial cable circuit in such manner that it shall be possible either to "tap off" a signal (possibly through a suitable isolation network not required as part of this contract) from the continuous coaxial circuit which both enters and leaves the box, or to interrupt the circuit and make separate connections to either or both ends. (It must be possible to restore the continuity of the circuit through the box without major effort.)

(c) Gaining access to any or all of the audio pairs in such manner that it shall be possible either to "tap off" a signal from a continuous circuit or to interrupt a circuit and make separate connections to the two ends.

__NOTE__: The "normal" cover plate for each receiver outlet box need provide only a coaxial fitting for connection to a television or FM receiver, but the design of the cover plate should permit the addition of other connectors for special access to either the coaxial or audio-pair circuits. In some classroom locations where television receivers are to be mounted near the ceiling, there may be two or more outlet boxes provided for the distribution system; in such cases, it is not necessary to provide full access to all circuits at the actual receiver outlet box, provided access is possible at a nearby junction or outlet box closer to floor level. The design of cover plates and facilities within each box shall permit access and revision of circuits with not more than about 10 minutes' labor.

3. The initial "master antenna" system shall have provision for reception of broadcast television signals on Channels 8 and 13, and distribution of said signals to all receiver outlets on Channels 2 and 6, respectively, utilizing Yagi antennas and channel conversion equipment already owned by Stephens College. It shall be the contractor's responsibility to remove and relocate the antennas and channel conversion equipment as part of this contract.

4. The initial "master antenna" system shall also have provision for distribution of at least two additional locally-generated television signals through standard television channels in the VHF spectrum.

5. The "master antenna" system shall be capable of expansion without obsolescence of any of the initial equipment to permit distribution of signals in the standard FM broadcast band and transmission of a minimum total of 7 television signals through standard broadcast channels in the VHF spectrum. Such additional signals may originate from "off-the-air" receivers or from additional closed-circuit facilities.

6. The "master antenna" system shall be so designed that the frequency spectrum from 0 to 50 mc may be utilized for transmission of video signals, standard television signals on sub-channels, or other special-purpose signals by the later installation of suitable terminal facilities, and without obsoleting any of the initial equipment.

7. The "master antenna" system shall be

designed to permit introduction of a modulated television signal through any receiver outlet box for transmission via an otherwise unused channel back to the Master Control Room, from whence said signal may be distributed throughout the entire system on the same or a different channel. Facilities at the receiver outlet box shall permit such introduction of a modulated signal with not more than 10 minutes' labor for revising circuit connections.

> NOTE: It is recognized that the second coaxial circuit could be used for such "inbound" signals without disturbing the basic "master antenna" system, but it is the desire of Stephens College not to be dependent upon the second coaxial circuit for this service.

D. Minimum Performance Requirements

1. The coaxial cable used shall be Type RG-11/U or approved equivalent with a nominal characteristic impendance of 75 ohms. Cable shall be pre-swept before installation to assure freedom from quality defects.

2. Each of the two coaxial cable circuits, including acces units, shall provide a minimum bandwidth of 0 to 220 megacycles, flat within 1 db across any 6 mc part of this spectrum from 50 to 220 mc, except that this specification shall not preclude the use of capacitive tap-off devices in the "master antenna" system.

3. The minimum signal level at any receiver outlet for any active television channel between 2 and 12 shall be 2,000 microvolts across 75 ohms. The maximum signal level for any television channel shall be 20,000 microvolts across 75 ohms.

4. The minimum RF isolation between any receiver and the cable shall be 15 db.

5. The voltage standing wave ratio for the distribution system shall not exceed 1.15.

6. The system shall be capable of transmitting compatible color television signals without noticeable deterioration of color fidelity or intelligence.

7. All equipment shall be designed for continuous operation, 24 hours per day.

E. Minimum Mechanical Requirements

1. Antennas shall be mounted on a mast or masts not exceeding 10 feet in height on the roof of Science Building "A," and shall be guyed to withstand 90 mph winds. Installer shall be expected to determine optimum location and orientation of antennas, although locations selected shall be subject to approval by Stephens College.

2. All electronic equipment must be supplied with evidence of approval by Underwriters Laboratories, Inc., and all cables and wiring must be installed in conformance with the National Electrical Code (and local codes, where applicable).

3. All electronic equipment must be mounted in adequately ventilated housings with provision for padlocks or other locking devices.

4. All access points, including receiver outlet boxes, shall be designed to discourage or prevent unauthorized tampering.

5. The system shall be complete with all wiring, connectors, amplifiers, power supplies, converters, and other components required to assure performance in accordance with these specifications.

F. Minimum Requirements for a Responsive Bid

1. Each bidder must describe completely the system he proposes to install, including technical specifications for the cable, terminal facilities, amplifiers, outlet box facilities, and other major components.

2. Each bid must be accompanied by a notarized statement by a licensed professional engineer certifying that the equipment offered meets the minimum performance specifications listed herein and such additional specifications as may be claimed by the bidder. Any exceptions to the minimum specifications must be clearly stated. The notarized statement shall be accompanied by a summary of the qualifications of the signatory professional engineer.

3. Each bid shall be accompanied by a statement of the manufacturer's or installer's policies with reference to instruction books, replacement parts, field modification service, and warranties. As a minimum warranty, all equipment, including wiring, cabling, and junction boxes, shall be guaranteed for a period of at least one year from the date of final acceptance thereof against electrical or mechanical defects or failures and two to three years against cable "creeping" or other distortions of mechanical nature.

4. A bid offering a system or equipment with features or performance specifications substantially in excess of the minimum specifications contained herein shall be entitled to preferential consideration only to the degree that the bidder can show that the non-specified features or performance characteristics are beneficial to Stephens College.

G. Contractor's Responsibility

1. The successful bidder shall be required to submit, before contracts are signed, complete wiring diagrams, equipment layout diagrams, and such other information as may be required by the Architect or Stephens College. Complete instruction books shall be supplied for each item of electronic equipment. Drawings supplied shall include a single-line drawing (or approved equivalent) showing all system devices with isolation values and calculated signal levels at the last outlet on each branch run.

2. Upon completion of the system installation, it shall be the responsibility of the contractor to make the necessary amplifier level adjustments and to perform such tests as may be required to show compliance with all system specifications.

APPENDIX B

LIST OF ELECTRONIC EQUIPMENT
SELECTED FOR THE
JAMES M. WOOD LEARNING CENTER
STEPHENS COLLEGE
COLUMBIA, MISSOURI
AUGUST 8, 1963

Electronic Equipment
for the
James M. Wood Learning Center
supplied by
General Electric Co.

Alternate A

1	BC-31-B	Audio Stereo Console, including: (1) BC-31-B (Basic) Console less relay modules (1) FA-51-A Equipment Shelf (1) BP-21-A Power Supply (4) BA-21-B Preamp Modules (1) BP-20-A Power Supply (3) FA-52-S Stereo Mixer (3) FA-52-M Monaural Mixer (2) BA-32-A Program Amp. (1) 77798765-5 VU Meter Kit (2) BA-34-A Monitor Amp. (2) FA-52-B Blank Module
2	A-7	Loudspeaker, Altec
1	804-B	Loudspeaker with 288C Driver, Altec-Lansing
1	Special	Console Desk Cabinet
1	MC-240	Amplifier, McIntosh
1	PR-10-2A	Tape Recorder, Ampex
1	96520-01	Remote Control, Ampex
1	96015-01	4 Track Accessory, Ampex
1		Audio Patch System, including: (1) FA-2-A Jack Strip less jacks (48) PJ-339 jacks, ADC (1) FA-3-A jack panel (3) PJ-82 Patch Cords, ADC
1	Special	Circuit Breaker Panel 5-Circuits
1	PR-1-A	Equipment Pack
1	PR-4-A	Terminal Board Frame
1	7118764	Audio Terminal Block
2	FS-12-A	Wall Speaker Assembly
1	FA-46-A	Equipment Shelf

2	FA-6-E	Blank Panel
1	FA-6-D	Blank Panel
1000'	FA-19-R	Audio Cable
1000'	8403	Microphone, Cable, Belden
500'	8760	Sound System Cable, Belden
100'	8780	Power Cable, Belden
7	Special	Microphone Wall Plates W/XLR-3-31 Connector Installed
1	Lot	Misc. Installation Material
1	Lot	Special Engineering & Material
1	Lot	Transportation Charges
1	MC-40	Amplifier, McIntosh
1	Lot	Product Service Supervision Engineering
1	Lot	Subcontractor Installation Labor

Alternate B

1	BC-31-B	Audio Monaural/Stereo Console, Incl: (1) BC-31-B Basic Console less (3) relay modules (1) FA-51-A Equipment Shelf (1) BP-21-A Power Supply (1) BP-20-A Power Supply (6) BA-21-B Preamp Module (2) FA-52-S Stereo Mixer (2) FA-52-M Monaural Mixer (2) BA-32-A Program Amp. (1) 7779865-5 VuMeter Kit (2) BA-34-A Monitor Amp. (2) FA-52-B Blank Module
1	Special	Audio Control System, Incl: (2) B-7492759-P1 Attenuators (2) BA-20-A Amplifiers (2) BA-32-A Program Amp. (2) B-7492839-P1 VuMeter (1) FA-51-A Equipment Shelf (1) BP-21-A Power Supply (6) 7479771-P2 Relays (2) 7600 Switch, Mossman

		System factory wired and tested
1	Special	Console Desk Cabinet for Item 1-B
1	Lot	Special Engineering and Material
1	Special	Console Desk Cabinet
4	BA-34-A	Monitor Amplifier
1	PR-10-2A	Tape Recorder, Ampex
1	96015-01	4 Track Accessory, Ampex
1	96520-01	Remote Control Unit, Ampex
4		Loud Speakers, Layton Model, Electro-voice.
2	FS-12-A	Loudspeaker Assembly
1	PR-1-A	Equipment Rack
1	PR-4-A	Terminal Board Frame
1	77118764	Audio Terminal Block
1		Audio Patch System, including: (1) FA-2-A Jack Strip, less jacks (48) PJ-339 Jacks, ADC (1) FA-3-A Jack Panel (3) PJ-82 Patch Cord, ADC
1	Special	A-C Circuit Breaker Panel
1	FA-46-A	Equipment Shelf
2	FA-6-D	Blank Panel
1	FA-6-E	Blank Panel
1500'	FA-19-R	Audio Cable
1000'	8403	Microphone Cable, Belden
500'	8762	Sound System Cable, Belden
100'	8780	Power Cable, Belden
6	Special	Microphone Wall Plates W/XLR-3-31 Connector Installed
1	Lot	Misc. Installation Material
1	Lot	Special Engineering & Material
1	Lot	Transportation Charges
1	Lot	Product Service Supervision Engineering
1	Lot	Subcontractor Installation Labor

Alternate C

1	BC-31-B	Audio Stereo Console, including: (1) BC-31-B (Basic) Console

		(1) FA-51-A Equipment Shelf
		(1) BP-21-A Power Supply
		(1) BP-20-A Power Supply
		(2) FA-52-S Stereo Mixer
		(2) FA-52-M Monaural Mixer
		(6) BA-21-B PreAmp Module
		(2) BA-32-A Program Amp.
		(2) BA-34-A Monitor Amp.
		(1) 7779865-5 VU Meter Kit
2	R-320	Turntable & Arm, Rek-O-Kut
2	VR-1000-7	Stereo Cartridge
2	BA-23-A	Turntable Stereo PreAmp
1	PR-10-2A	Tape Recorder, Ampex
1	96520-01	Remote Control Unit, Ampex
1	96015-01	4 Track Accessory, Ampex
2		Loudspeaker, Leyton Model, Electro-Voice
2	FS-12-A	Loudspeaker Assembly
1		Audio Patch System, including:
		(1) FA-2-A Jack Strip, less jacks
		(48) PJ-339 Jacks, ADC
		(3) PJ-82 Patch Cord, ADC
		(1) FA-3-A Jack Panel
1	PR-1-A	Equipment Rack
1	PR-4-A	Terminal Board Frame
1	77118764-G1	Audio Terminal Block
2	C-7BT	Turntable Cabinet, Rek-O-Kut
1	Special	A-C Circuit Breaker Panel
1	Special	Console Desk Cabinet
3	FA-6-D	Blank Panel
2	FA-6-B	Blank Panel
1500'	FA-19-R	Audio Cable
500'	8403	Microphone Cable, Belden
500'	8762	Sound System Cable, Belden
100'	8780	Power Cable, Belden
6	Special	Microphone Wall Plates W/XLR-3-31 Connector Installed
1	Lot	Misc. Installation Material
1	Lot	Special Engineering & Material
1	Lot	Transportation Charges
1	Lot	Product Service Supervision

		Engineering
1	Lot	Subcontractor Installation Labor

Alternate D

2	BC-31-B	Audio Monaural/Stereo Console, Incl:
		(1) BC-31-B Basic Console
		(1) FA-51-A Equipment Shelf
		(1) BP-21-A Power Supply
		(1) BP-20-A Power Supply
		(5) BA-21-B Preamp Module
		(2) FA-52-M Monaural Mixer
		(2) BA-32-A Program Amp
		(2) BA-34-A Monitor Amp
		(1) 7779865-5 VuMeter Kit
		(5) FA-52-B Blank Module
2	Special	Console Desk Cabinet
2	Leyton	Loudspeaker, Electro-Voice
4	FS-12-A	Wallspeaker Assembly
2	R-320	Turntable & Arm, Rek-O-Kut
2	C-7BT	Turntable Cabinet, Rek-O-Kut
2	VR-1000-7	Stereo Cartridge
2	BA-23-A	Turntable PreAmp.
1	PR-10-2A	Tape Recorder, Ampex
2	96520-01	Remote Control, Ampex
1		Audio Patch System, including:
		(2) FA-2-A Jack Strip
		(2) FA-3-A Jack Panel
		(4) FA-7-A Patch Cord
1	PR-1-A	Equipment Rack
1	PR-4-A	Terminal Board Frame
1	77118764-1	Audio Terminal Block
2	FA-6-E	Blank Panel
1	FA-6-D	Blank Panel
1	Special	A-C Circuit Breaker Panel
2500'	FA-10-R	Audio Cable
2000'	8403	Microphone Cable, Belden
100'	8780	Power Cable, Belden
500'	8762	Sound System Cable, Belden
14	Special	Microphone Wall Plates W/XLR-3-31 Connector installed

1	Lot	Misc. Installation Material
1	Lot	Special Engineering & Material
1	Lot	Transportation Charges
1	Lot	Product Service Supervision Engineering

Alternate E

3	PE-23-C	Studio Vidicon Camera Channel, including: (1) PC-14-A Camera W/viewfinder (1) TC-60-A Control Unit (1) 7672541-G1 Control Unit Adapter (1) 7672544-G1 Interconnection Unit (1) 7779220-P1 Cover Panel (1) 7779219-P1 Rack Adapter (1) 7779356-G1 Wiring Harness (1) 7666932-G7 Camera Cable (2) 7141069-P3 Single Headset (1) 7735A Vidicon Camera Tube
3	PV-15-A	50' Camera Cable
3	7666932-G7	75' Camera Cable W/right angle connector
3	7672612-G1	Video Dist. Amp.
3	7496566-G1	Tally Switch
3	7779257-G1	Tally Switch Power Supply
3		25mm Lens, "C" Mount Ektar
3		50mm Lens, "C" Mount Ektar
3		102mm Lens, "C" Mount Ektar
3	MCH-3	Cradle Head, Houston Fearless
3	PD-5-A	Camera Mounts, Houston Fearless
7	7141069-P3	Single Headsets
13	7165590-4	Intercom Amplifier
5	PV-9-A	Termination Plugs
1	Special	Camera Cable Patch Panel, for Master Control
2	Special	Studio Camera Cable Receptacle Box
1	PE-21-A	Vidicon Film Camera Channel, Including:

		(1) PC-13-A Camera W/7038 Tube
		(1) TC-58-A Control Unit
		(1) TP-32-A Power Supply
		(1) TV-99-A Channel Amp.
		(1) 7672025 Interconnection Panel
		(1) 7170056-1 Rack Wiring Harness
		(1) 7666932-5 Camera Cable
		(1) 7666932-5 Rack to Console Cable
		(5) PV-9-A Termination Plug
1	CDVM-614	Film Projector, 15mm W/4 inch lens, Bell & Howell
1	TV-86-C	Optical Multiplexer
1	TV-95-B	AGC/ATC Amplifier
3	TC-48-B	Remote Projector Control
2	TC-48-A2	Modified for Delegation Function
1	7173747	Power Supply

STUDIO A CONTROL ROOM

1		Switching System, including:
		(1) TC59 Switch Panel Special (3 noncomposite)
		(1) TV-76-A Mixer Amp.
		(1) TV-90-A Mixer Amp.
1	Special	Console Desk cabinet, 96" long
7	CKB-14	14" Monitor, Conrac
1	CAM602YVY	17" TV Receiver, G. E.
1	Special	Paging system, including:
		(1) CHB-10 10 watt Amp., Bogan
		(1) 634 Microphone, Electro-Voice
		(1) Misc. Material
3	TV-102-A	Distribution Amp.
1	FA-51-B	Equipment Shelf
1	TH-27-A	Monitor, 21"
1		Rollaround Dolly for TH-27-A

MASTER CONTROL ROOM

1	CNB8/2R	Dual 8" Monitor
2	CNB8/RTR	Dual 8" Monitor
4	527	Scopes, Tektronix

1	R8TT	Cradle Assembly, Tektronix
1	PD-16-B	Pulse Dist. Amp., Dynair
1	Lot	Special parts to connect RCA and GE Intercom circuits
2	FR-72	series Console Cabinet, Special, Emcor
1	FR-72	series Console Cabinet, Special Mobile, Emcor
3	Special	Blowers for Console, Emcor
1	VS-12L-A	Monitor Switcher, Dynair
5	924-B	Video Patch Panel, Nems-Clarke
12	967-GA	Patch Cords, Nems-Clarke
60	965/865	Looping Plugs, Nems-Clarke
4	PR-1-A	Cabinet Rack
500	PL259/UG176-U	Coax Connector
5000'	RG11/U	Coax Cable
2000'	RG25/U	Coax Cable
1000'	8780	Power Cable, Belden
1	Lot 8748	Remote Control Cable
4	Special	A-C Circuit Breaker Panel
1	Lot	Misc. Installation Material
1	Lot	Special Engineering and Material
1	Lot	Transportation Charges

Alternate H

Cable Distribution System

116	PT-1461	Tapoff, Jerrold
116	F-81	Chassis Connect, Jerrold
260	F-59-A	Male Cable Connector
11.3	M'8261	RG11A/U Cable, Belden
6.25	M'8768	Cable, Belden, 6SH pr's
1		WCON 2 Channel VHF to VHF Conver Sion
1		Power Supply for WCON
1M'	RG-59/U	Belden 8263
1	EH40	Cable, Jerrold
1	MP1	Switch
1	MP2	Switch
1	RPS300B	Panel
4	PMA	Caan. Amp., Jerrold

4	2300	Amp., Jerrold
2		Yagi Ant.
116		Cover Boxes
130	F-101-59	Adapter Assy.
2	MTUO-374	Unit, Jerrold
33	Model 1592	Splitters
1	Lot	Misc. Hardware
1	Model 704B	Field Strength Meter
1	Lot	Product Service Supervision Engineering
1	Lot	Subcontractor Installation Labor

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Electronic Equipment
for the
James M. Wood Learning Center
supplied by
Staples-Hoppmann, Inc.

Alternate G

Assembly Hall System

1	16 mm Motion Picture Projector, Bell & Howell #542
2	2" x 2" Slide Projector, Staples-Hoppmann Random Access 46
1	Filmstrip Projector, Viewlex V-500
1	Trip-Cue Unit, Staples-Hoppmann
2	Trip-Cue Generators, Staples-Hoppmann
1	Signalling Circuit, Staples-Hoppmann
1	Lectern, Staples-Hoppmann
1	Screen, 12 x 20, Radiant
1	Projection Module, Staples-Hoppmann
1	Polarizing Attachment, Staples-Hoppmann
1	T-V Projector, Tele-Beam Div. #A-9RB
1	Overhead Projector, Staples-Hoppmann (Combination Projector)
1	Stand for overhead projector, Staples-Hoppmann

Cinema Lab and Multi-Purpose Room

2	16 mm Motion Picture Projector, Bell & Howell #542
2	2" x 2" Slide Projectors, Staples-Hoppmann Random Access 46
2	Filmstrip Projectors, Viewlex V-500
2	8' x 8' Roll-up Screens, Radiant
1	12' x 16' Roll-up Screen (electric), Radiant
1	Trip Cue Unit, Staples-Hoppmann
2	T-V Receiver 23", Setchell-Carlson

2	Lectern, Staples-Hoppmann
2	Overhead Projector, Staples-Hoppmann (Combination Projector)
1	Projection Module, Staples-Hoppmann
1	Stand for overhead projector, Staples-Hoppmann
2	Signal Circuit, Staples-Hoppmann

Classroom System

15	T-V Receivers 23", Setchell-Carlson
15	60" x 60" Screens, wall mtd., Radiant
30	Speakers, Altec #601
15	Amplifier, EICO ST-70
15	A-V Control Panel, Staples-Hoppmann
6	A-V consoles with Tape Deck, Viking 230 Turntable, Rek-O-Kut (supplied by Stephens College) Trip Cue, Unit, Staples-Hoppman Teacher's Desk, Staples-Hoppmann Overhead Projector, Staples-Hoppmann (Combination Projector) Stand for overhead projector
6	16 mm Motion Picture Projector, Bell & Howell #542
6	Stands for Motion Picture Projector, Staples-Hoppmann
6	2" x 2" Slide Projector, Staples-Hoppmann Random Access 46
6	Stands for slide projector, Staples-Hoppmann
6	Filmstrip Projector, Viewlex V-500
6	Stands for filmstrip projector, Staples-Hoppmann